Reliability Report

TPS7H410x-SEP Production Flow and Reliability Report

Abstract

TI Device: TPS7H410x-SEP

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 Space 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 Space Enhanced Products meet GEIA-STD-0002-1.

Trademarks

All trademarks are the property of their respective owners.

Copyright © 2026 Texas Instruments Incorporated

1 Space Enhanced Plastic Production Flow

1.1 Device Introduction

TPS7H410x-SEP is a radiation tolerant device in a plastic package which is qualified and screened for space applications. The device was verified immune to 43MeV-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 50krad(Si) and each assembly and test lot follows the process flow shown in Figure 1-1. To maintain the quality of TPS7H410x-SEP, the device is qualified with Space EP requirements. See Section 2 for further details.

Copyright © 2026 Texas Instruments Incorporated

1.2 TPS7H410x-SEP Space Enhanced Plastic Production Flow

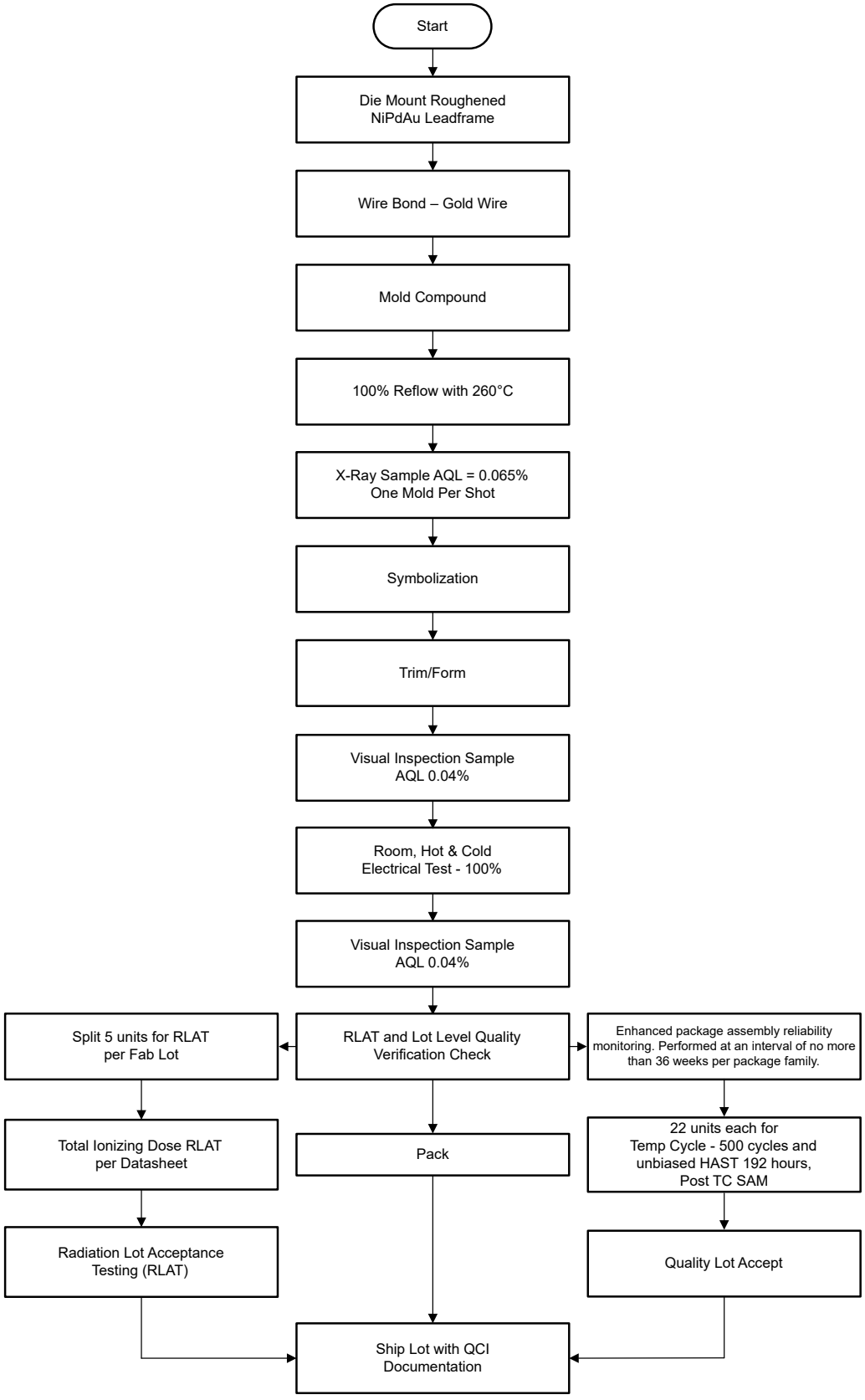


Figure 1-1. TPS7H410x-SEP Space Enhanced Plastic Production Flow Chart

Copyright © 2026 Texas Instruments Incorporated

2 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 2-1. Space Enhanced Products New Device Qualification Matrix

Note that qualification by similarity (*qualification family*) per JEDEC JESD47 is allowed.				
DESCRIPTION	**CONDITION**	**SAMPLE SIZE USED/REJECTS**	**LOTS REQUIRED**	**TEST METHOD**
Electromigration	-	N/A	N/A	Per TI Design Rules
Wire Bond Life	-	N/A	N/A	Per TI 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
Biased HAST	130°C / 85% / 96 hours or 110°C / 85% / 264 hours or 85°C / 85% / 1000 hours	77/0	3	JESD22-A110/A101 (1)
Extended Biased HAST(2)	130°C / 85% / 192 hours 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 110°C / 85% / 264 hours or 85°C / 85% / 1000 hours	77/0	3	JESD22-A.118(1)
Temperature Cycle	-65°C to +150°C non-biased for 500 cycles or equivalent	77/0	3	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	5 units x 30/0 bonds	3	JESD22-B116
Bond Pull Strength	Per wire size	5 units x 30/0 bonds	3	ASTM F-459
Die Shear	Per die size	5/0	3	MIL-STD-883, TM 2019
High Temperature Storage	175 °C / 420 hours or equivalent	15/0	3	JESD22-A103
Moisture Sensitivity	Surface Mount Only	12	1	J-STD-020
Radiation Response Characterization	Per TI Data sheet	-	1	Refer to Radiation Reports

Copyright © 2026 Texas Instruments Incorporated

Table 2-1. Space Enhanced Products New Device Qualification Matrix (continued)

Note that qualification by similarity (*qualification family*) 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)	-(3)	1	ASTM E595(3)

(1) Precondition performed per JEDEC Std. 22, Method A112/A113.
(2) For information only.
(3) Outgassing test was performed on representative 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.

Copyright © 2026 Texas Instruments Incorporated

Technology Family FIT / MTBF Data
Mean Time Between Fails (MTBF) and Failures in Time (FIT) rates are device reliability statistics calculated based on data collected from TI's internal reliability testing (life test). TI's DPPM/FIT/MTBF Estimator Search Tool reports the generic data based on technology groupings and shows conditions under which the rates were derived. All terms used in the tool and definitions can be found on the TI reliability terminology page. Failure rates are summarized by technology and mapped to the associated material part numbers. The failure rates are highly dependent on the number of units tested, therefore, it is not recommended to compare failure rates. TI DPPM/FIT/MTBF Estimator Search Tool webpage link: www.ti.com/quality/docs/estimator.tsp

Device Family Qualification Data
TI's Qualification Summary Search Tool reports generic qualification data representative of the material sets, processes, and manufacturing sites used by the device family and may not include all of the testing performed for a specific SEP device. Please see the Space Enhanced Products New Device Qualification Matrix above for the full suite of qualification testing performed to release Space Enhanced Product devices. TI Qualification Summary Search webpage link: www.ti.com/qualificationsummary/qualsumm/home

Ongoing Reliability Monitoring
TI periodically monitors the reliability of its products, wafer fab processes, and package technologies, through its Ongoing Reliability Monitor (ORM) program. The ORM program involves collecting environmental reliability stress data on representative sets of devices, processes and packages. The results from the ORM program are updated quarterly in this report. TI Ongoing Reliability Monitoring Search webpage link: www.ti.com/orm/home?actionId=2801.html

For additional information or technical support please contact the Texas Instruments Customer Support Center.
For more information on TI Space Enhanced Products, click here.

4 Revision History

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

Changes from Revision B (August 2026) to Revision C (November 2026)	Page
• Updated Production Flow Chart	3

Changes from Revision A (November 2025) to Revision B (August 2026)	Page
• Updated Production Flow Chart	3

Copyright © 2026 Texas Instruments Incorporated

Important Limitations on Use of Data Exceeding Specified Limits

TI is providing this data for your convenience. However, we want to make clear the significant limitations of its usefulness as an indicator of how devices may perform in various applications.

THIS DATA IS PROVIDED "AS IS" WITHOUT ANY EXPRESS OR IMPLIED WARRANTY OF ANY KIND INCLUDING WARRANTIES OF MERCHANTABILITY, NONINFRINGEMENT OF INTELLECTUAL PROPERTY, OR FITNESS FOR ANY PARTICULAR PURPOSE. IN NO EVENT SHALL TI OR ITS SUPPLIERS BE LIABLE FOR ANY DAMAGES WHATSOEVER (INCLUDING, WITHOUT LIMITATION, DAMAGES FOR LOSS OF PROFITS, BUSINESS INTERRUPTION, LOSS OF INFORMATION) ARISING OUT OF THE USE OF OR INABILITY TO USE THE INFORMATION, EVEN IF TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

Your use of this data, and all consequences of such use, is solely your responsibility. You must perform sufficient engineering and additional qualification testing in order to properly evaluate your application and determine whether a candidate device is suitable for use in that application.

TI semiconductor components are specifically designed and manufactured to be used within the electrical, thermal, mechanical and other parameters set forth in TI's product data sheets. Quality and reliability data provided by Texas Instruments, such as MTBF and fit rate data, is intended to be an estimate of product performance based upon history only. It does not imply that any performance levels reflected in such data can be met if the product is operated outside the conditions expressly stated in the latest published data sheet for a device.

Plastic encapsulated TI semiconductor devices are neither designed nor warranted as suitable for use in military applications and/or military environments.

THIS INFORMATION SHOULD NOT BE USED TO ASSIST IN THE PRACTICE OF "UPRATING" OR "UPSCREENING" DEVICES FOR USE IN MILITARY OR OTHER CRITICAL APPLICATIONS. There are significant limitations of this information as an indicator of how commercial, off-the-shelf (COTS) devices may perform in such applications or environments, and about the hazards of using COTS devices in such applications. TI strongly believes that semiconductor components should never be used outside their specified tolerance levels as up-screening can lead directly to system or component failure. Such failures may present distinct risks to end-users and to third parties. TI cannot accept any responsibility for component or system failures that occur due to the misuse of its products, including misuse that may result from the practice of up-screening.

Any use of TI components beyond their rated limits voids all warranty responsibility of TI with respect to such devices, and also voids all responsibility of TI with respect to any applications assistance, product design, software performance or services of any kind that were or may have been performed in connection with the sale of any such devices. Further, resale of TI's products or services with statements different from or beyond the parameters stated by TI for that product or service in official TI data books or data sheets, or without the warnings or instructions provided by TI, voids all express and any implied warranties for the associated TI product or service, and is an unfair and deceptive business practice.

IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATASHEETS), 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 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, TI’s General Quality Guidelines, 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. Unless TI explicitly designates a product as custom or customer-specified, TI products are standard, catalog, general purpose devices.

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

Copyright © 2026, Texas Instruments Incorporated

Last updated 10/2025

IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATASHEETS), 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 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, TI’s General Quality Guidelines, 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. Unless TI explicitly designates a product as custom or customer-specified, TI products are standard, catalog, general purpose devices.

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

Copyright © 2026, Texas Instruments Incorporated

Last updated 10/2025