Reliability Report

TMS5704357-SEP Production Flow and Reliability Report

ABSTRACT

The TMS570LC4357-SEP device is part of the Hercules TMS570 series of high-performance Arm® Cortex®-R-based MCUs. The TMS570LC4357-SEP device features on-chip diagnostic features including: dual CPUs in lockstep, Built-In Self-Test (BIST) logic for CPU, the N2HET coprocessors, and for on-chip SRAMs; ECC protection on the L1 caches, L2 flash, and SRAM memories. The device also supports ECC or parity protection on peripheral memories and loopback capability on peripheral I/Os.

The TMS570LC4357-SEP is manufactured with a controlled baseline and features the following:

- One assembly and 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 verify 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 provides 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 Production Flow

2.1 Device Introduction

TMS570LC4357-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 48 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 30 krad(Si) and each assembly and test lot follows the process flow shown in Figure 2-1. To verify the quality of TMS570LC4357-SEP, the device is qualified with Space EP requirements.

2.2 TMS570LC4357-SEP Production Flow

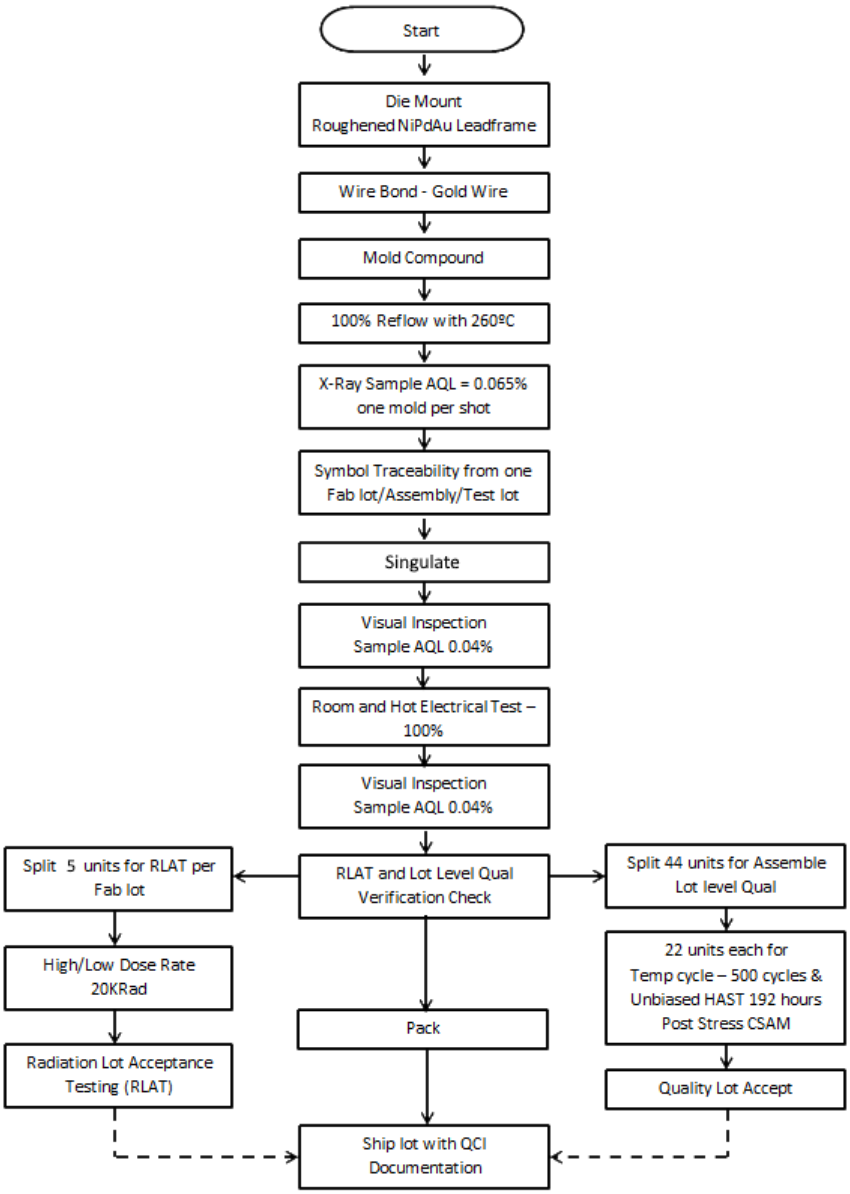

Figure 2-1. TMS570LC4357-SEP Production Flow Diagram

3 Device Qualification

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. The QBS rules for a technology, product, test parameters or package shall define which attributes are required to remain fixed in order for the QBS rules to apply. The attributes which are expected and allowed to vary will be 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.

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 EP device. Please see the Enhanced Products New Device Qualification Matrix above for the full suite of qualification testing performed to release 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 at www.ti.com/csc For more information on TI Enhanced Products please visit www.ti.com/ep

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 or Rejects)	Lots Required	Test Method
Sample Device	TMS5704357BGWTSEP			
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 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	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 *or* 110°C / 85% / 264 hours *or* 85°C / 85% / 1000 hours	77/0	3	JESD22-A110/A101*
Extended Biased HAST	130°C / 85% / 250 hours *or* 110°C / 85% / 687 hours *or* 85°C / 85% / 2600 hours	77/0	1	JESD22-A110/A101*
Unbiased HAST	130°C / 85% / 96 hours *or* equivalent	77/0	3	JESD22-A118*
Temperature Cycle	-65°C to +150°C non-biased 500 cycles *or* equivalent	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	J-STD-002	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	MIL-STD-883, TM 2019
High Temperature Storage	150°C / 1000 hours	15/0	3	JESD22-A103*
Moisture Sensitivity	Surface Mount Only	12	1	J-STD-020*
Radiation Response Characterization	TI Data Sheet	5 units/dose level	1	MIL-STD-883/Method 1019
Outgassing Characterization	TML <=1% (Total Mass Lost) CVCM <=0.1% (Collected Volatile Condensable Material)	5	1	ASTM E595

4 Outgas Test Report

Outgassing test was performed on five units. A total mass loss (TML) of 1 % 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.

SAMPLE	TML< 1.0%	CVCM< 0.1%
TMS5704357BGWTSEP	PASS	PASS

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