Radiation Report

LMX2694-SEP Production Flow and Reliability Report

ABSTRACT

This report presents the reliability and qualification results for the LMX2694-SEP: A high-performance, wideband phase-locked loop (PLL) with an integrated voltage-controlled oscillator (VCO) and voltage regulators that can output any frequency between 39.3 MHz and 15.1 GHz without a doubler, eliminating the need for ½ harmonic filters. The LMX2694-SEP 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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Trademarks

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 can 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 are certified to meet GEIA-STD-0002-1 Aerospace Qualified Electronic Components.

2 Space Enhanced Plastic Production Flow

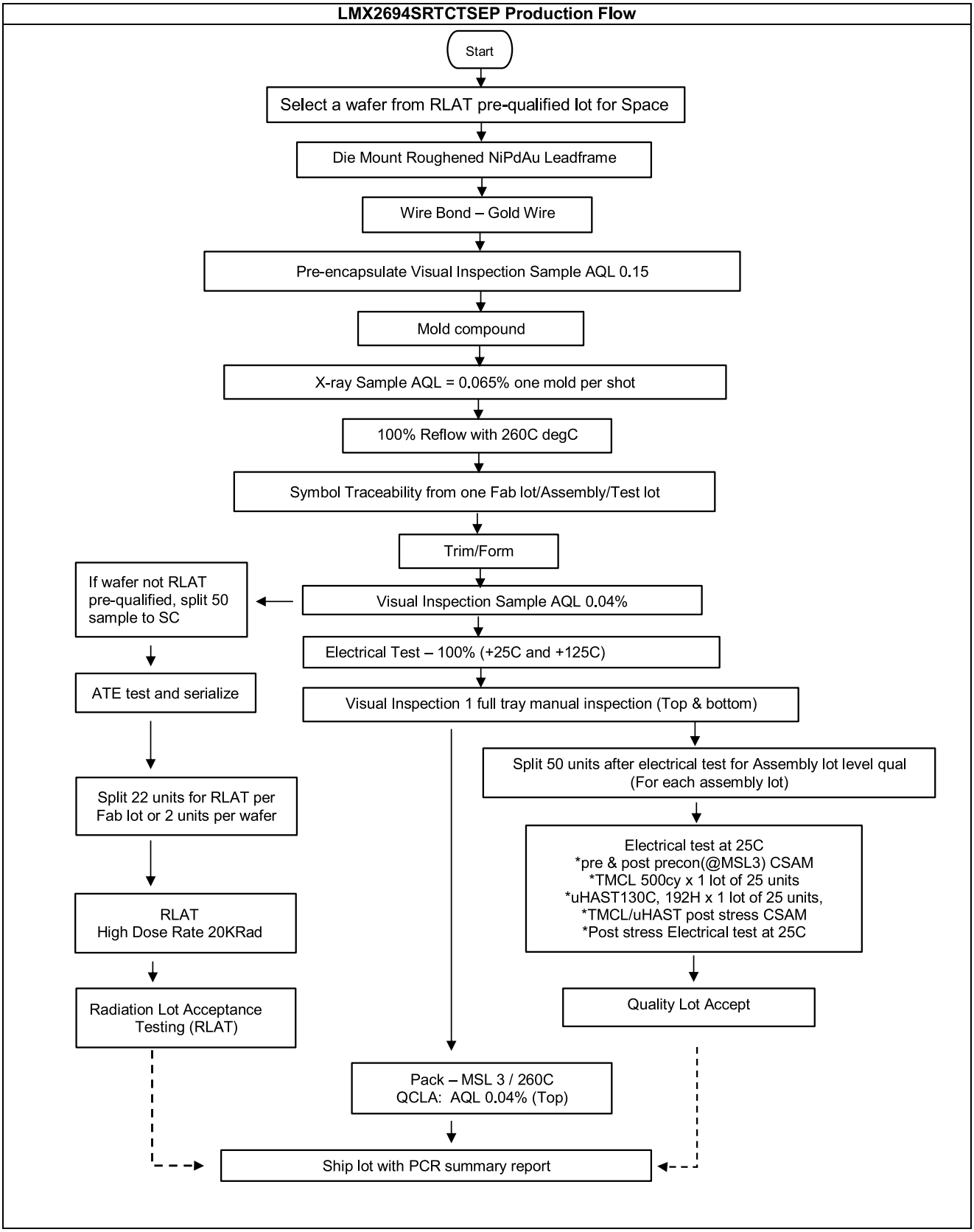

Figure 2-1. Space Enhanced Plastic Production Flow

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 a previously qualified device or devices 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.

Table 3-1. Device Baseline

TI DEVICE	LMX2694SRTCTSEP		ASSEMBLY SITE	TI-MLA (MALAYSIA)
DLA VID	V62/19616-02XE		Test Site	TI PHILIPPINES CLARK A/T
Wafer Fab	Texas Instruments Deutschland- FFAB (Freising)		Pin/Package Type	VQFNP (RTC) 48
Fab Process	BICMOS13		Leadframe	Cu
Fab Technology	CMOS		Termination Finish	NiPdAu-Ag
ESD HBM	±1000 V		Bond Wire	25.4 µm Au
ESD CDM	±1000 V		Moisture Sensitivity	MSL 3/260°C
Baseline information in effect as of the date of this report				

Table 3-2. 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	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*
Unbiased HAST	130°C/85%/96 hours	77/0	3	JESD22-A.118*
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/Method B	5/0	1	UL-1964

Table 3-2. 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**
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	TM 2019
High Temp Storage	150°C/1,000 hours	15/0	3	JESD22-A103-A*
Moisture Sensitivity	Surface Mount Only	12	1	J-STD-020-A*
Radiation Response Characterization	Total Ionization Dose, and Single-Event Latchup	5 units/dose level	1	MIL-STD-883/Method 1019
Outgassing Characterization	TML (Total Mass Lost), CVCM (Collected Volatile Condensable material), WVR (Water vapor recorded)	5	1	ASTM E595
Single-Event (SEE)	Single Event (SEL)	5	1	MIL-STD-883/Method 1019
Radiation Response Characterization (TID)	Total Ionization Dose	2 units/per wafer qualification	1	MIL-STD-883/Method 1019
*Precondition performed per JEDEC Std. 22, Method A112/A113				

4 Outgas Test Report

Outgassing test was performed on five 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, CVCM, and the amount of Water Vapor Recovered (WVR) were measured after the test.

Table 4-1. Outgas Test Results

SAMPLE	TML (%)	CVCM (%)	WVR (%)
LMX2694-SEP	0.05	<0.01	<0.04

Quality and Reliability Data Disclaimer

The attached quality and reliability information is specific to the TI Space Enhanced Plastic product family of plastic encapsulated commercial-off-the-shelf (COTS) semiconductor products and components. Due to po ssible differences in product assembly and test baselines, this information is NOT APPLICABLE to TI standard, industrial, or automotive catalog commercial products.

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5 Revision History

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

Changes from Revision A (December 2019) to Revision B (April 2022)	Page
• Changed Table 3-1 and Table 3-2	4

Changes from Revision * (November 2019) to Revision A (December 2019)	Page
• Removed Mount compound from Table 3-1	4
• Removed Mold compound from Table 3-1	4
• Removed extended biased HAST from Table 3-2	4

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