



ABSTRACT

This report presents the reliability and qualification results for the AFE7950-SP (Radiation-hardness-assured (RHA)), 100-krad, 4T6R RF Sampling AFE with 12GSPS DACs and 3GSPS ADCs. The AFE7950-SP is manufactured with a controlled baseline that contains the following:

- An extended product life cycle
 - One assembly and test site
 - Product traceability
 - Extended product-change notification
 - Radiation lot acceptance testing
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1 Texas Instruments 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 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 maintain 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 High Grade in Plastic Production Flow

Device Introduction

The AFE7950-SP is a radiation-hardened device in a plastic package that allows these devices to be used in space applications. The device was verified immune to $70\text{MeV} \times \text{cm}^2/\text{mg}$ at 125°C for single-event latch-up (SEL) and single-event functional interrupt (SEFI). Each fabrication lot was tested according to MIL-STD-883 for radiation lot acceptance tested (RLAT) up to 100krad (Si) and each assembly and test lot follows the process flow shown in [Figure 2-1](#). To verify the quality of the AFE7950-SP, the device is qualified with SHP requirements. For more details, see [Section 3](#).

AFE7950-SP Space High Grade in Plastic Production Flow Chart

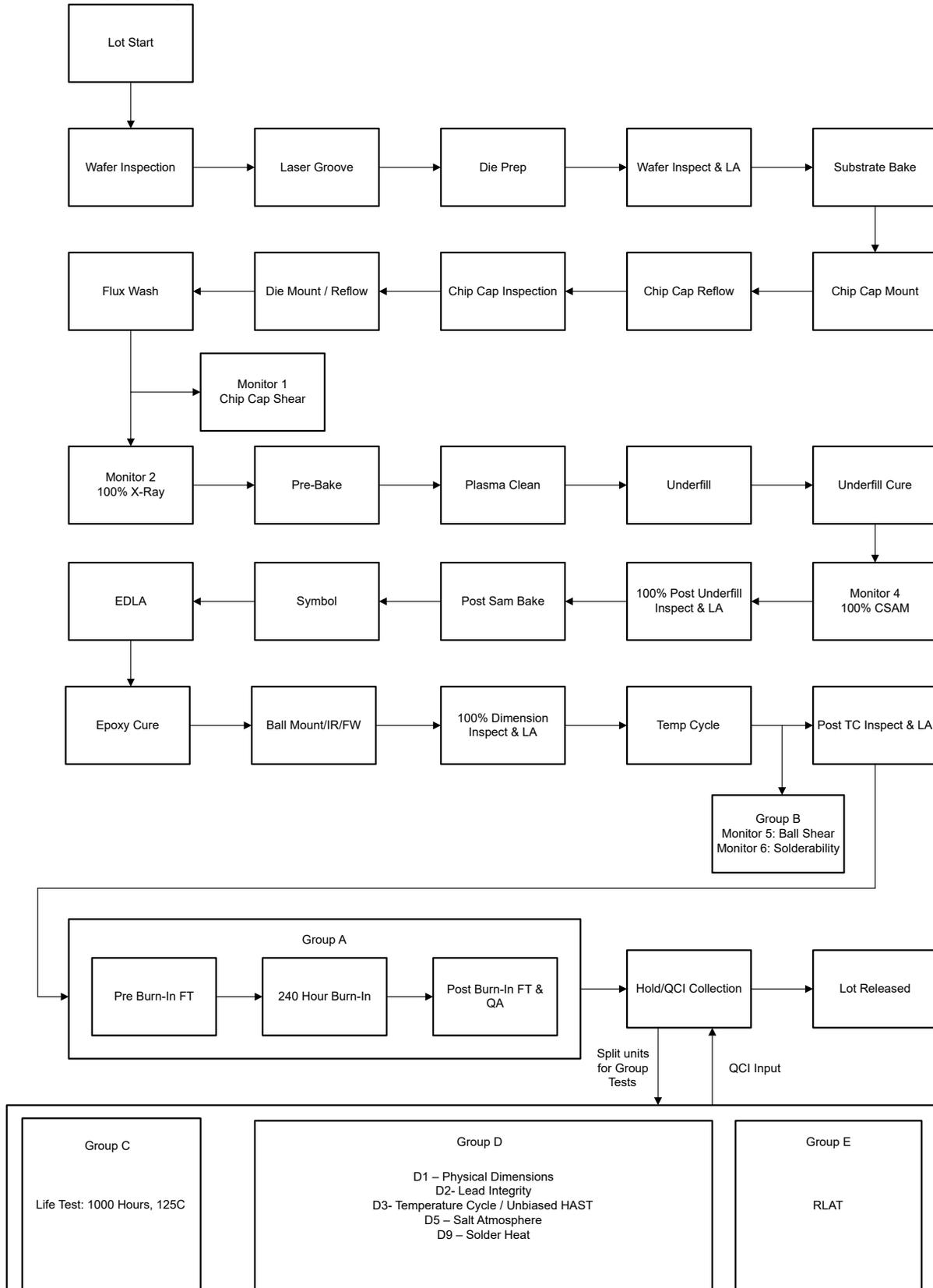


Figure 2-1. AFE7950-SHP : Group Test Flow

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 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 in order 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 3-1. Device Baseline

TI Device	AFE7950ALKSHP	Assembly Site	TI-PHI (Phillipines)
Wafer Fab	TSMC F15	Test Site	TI-PHI (Phillipines)
Fab Process	TSMC C28.HPC+	Pin and Package type	ALK, 400
Fab Technology	TSMC C28.HPC+	Substrate	Pb Free SOP/uBall
Die Revision	A	Termination Finish	SnAgCu
ESD CDM	±150V	Chip Cap Termination	Pure Sn
ESD HBM	±1000V	Moisture Sensitivity	MSL 3/ 220°C

Table 3-2. Space Products New Device Qualification Matrix

Req name	Method / Conditions	Lots / Devices	SS / Accept
Precon MSL3	MSL3 220°C	1	120/0
UHAST (110°C)	110C/85%RH, 264, 528 Hours	1	30/0
BHAST (110°C)	110C/85%RH, 264, 528 Hours	1	30/0
HTSL (150°C)	150C, 1000 Hours	1	30/0
Temperature Cycle	-55C/125C, 700 cycles	1	30/0
Solderability	22 leads/lot, min 3 devices. 245C + 5C Condition A (steam age for 8 hours)	1	3/0
Physical Dimensions	Per case outline drawing	1	15/0
D3 per QCI plan	Precon MSL3, 220C b) JESD22-A104, -55/125C, 100 cycles c) JESD22-A118, 110C/85%RH, 264 hours	1	15/0
D5 Salt Atmosphere, per QCI plan	Condition A, per 883 TM1009	1	15/0
ESD CDM	JS-002, 150V	1	3/0
ESD HBM	JS-001, 1KV	1	3/0
Latch-Up HT	JESD78, 105C	1	3/0
C1 - Life Test, 125°C	TM1005 125C, 1000 Hours	1	45/0
Outgassing Characterization	ASTM E595 TML <=1% CVCM <=0.1%	-	PASS
Thermal Resistance QML	Simulation	-	See Data sheet / Complete
Radiation Response Characterization	Total ionization dose, single-event latch-up MIL-STD-883/Method 1019	1	Complete (Refer to radiation report on www.ti.com)

4 Outgas Test Report

The 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.

Table 4-1. Outgas Test Results

Sample	Material	TML 1%	CVCM < 0.1%
AFE7950ALKSHP	Underfill	PASS	PASS
AFE7950ALKSHP	Substrate	PASS	PASS
AFE7950ALKSHP	TIM	PASS	PASS

5 Construction Exceptions and Manufacturing Flow Optimizations

Table 5-1 lists

Table 5-1. Construction Exceptions and Manufacturing Flow Optimizations

MIL-PRF-38535 Item	Construction and Exception
Eutectic SnPb solder bumps	Pb-free solder bumps
Chip Caps termination	Chip caps with pure-Sn termination
Production burn-in	240 Hours at 105°C

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