Summary of the LEO generic specification for power discrete device

Introduction

Taking full advantage of its over 40-year aerospace heritage and its automotive AEC-Q101-qualified production lines, STMicroelectronics introduces a new series of rad-hard components in plastic packages to support the growing low Earth orbit (LEO) and New Space satellite markets.

Among these are power discrete devices, including diodes and rectifiers, which address the performance and reliability challenges of satellite constellations within a strict budget, thanks to the STMicroelectronics LEO generic specification dedicated to space-ready rad-hard plastic power discretes.

These space-ready, automotive-based products provide a balance among footprint size savings, total cost of ownership, and quality assurance, together with radiation hardness and large production capacity.

This note describes the STMicroelectronics process dedicated to this new series of power discrete components.

Benefits

- Lower total cost of ownership
- Cosmic radiation specified in total ionizing dose (TID), total non-ionizing dose (TNID), and single-event effects (SEE)
- AEC-Q101 product qualification-based
- Automotive screening and full wafer lot traceability
- IATF 16949-certified production with large capacity
- Lightweight and compact devices
- Whisker-free lead finishing, JESD201 class 2 compliant

1 Simplified LEO power discrete component qualification flow

The product development of rad-hard plastics LEO products complies with the *ST LEO generic specification* and ST standard procedures for product development and maturity.

Figure 1. LEO qualification process flow

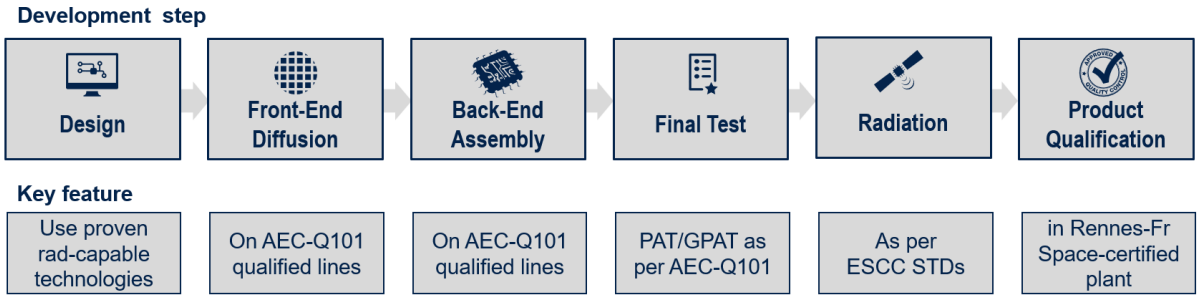


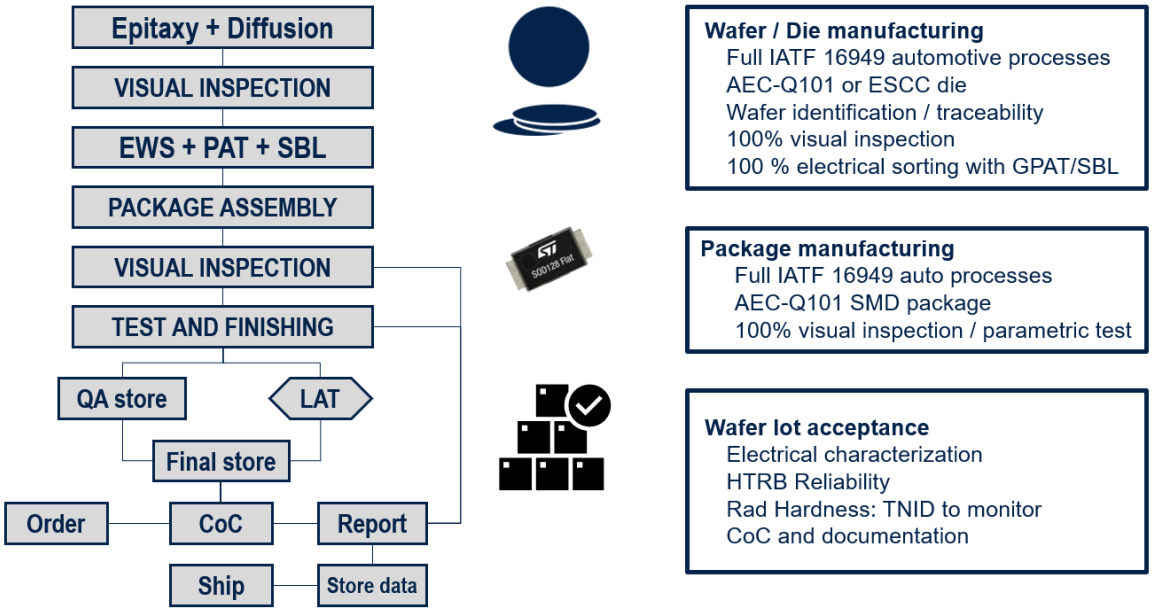
Table 1. LEO power discrete component qualification flow

Operating phase	Description	Reference
Design and Validation	Samples assembled in final package	ST operation procedure
	Electrical characterization	ST specification, AEC-Q003
	ESD characterization, HBM	AEC Q101-001
	ESD characterization, CDM	AEC Q101-005
	Thermal resistance	Thermal resistance JESD24-3, JESD24-4, JESD24-6
Qualification, reliability, and package requirements	PC, preconditioning	J-STD-020, JESD22-A113
	Moisture sensitivity level (MSL) research	J-STD-020
	UHAST, unbiased highly accelerated stress test	JESD22A-118, or A101
	H3TRB, high humidity high temperature reverse bias	JESD22A-101
	TC, temperature cycling test	JESD22A-104
	Destructive physical analysis (DPA)	AEC-Q101-004 section 4 after TC and H3TRB
	IOLT, intermittent operational Life test	MIL-STD-750 method 1037
	HTRB, high temperature reverse bias	MIL-STD-750 method 1038A
	RSH, resistance to solder heat	JESD22-A111 (SMD), JESD22-B106 (PTH)
	Solderability	J-STD-002, JESD22B102
	Whisker growth evaluation	AEC-Q005, JESD201 class 2
	Outgassing	As per ASTM E 595
Cosmic radiations	SEE	ESCC25100, JESD57
	TID	ESCC22900
	TNID	ESCC22500

2 LEO power discrete devices manufacturing flow and supply chain

The flow and supply chain of the rad-hard plastics low earth orbit (LEO) products comply with the ST LEO generic specification and ST standard procedures for a product maturity and controls.

Figure 2. LEO production process flow



Key benefits

- ST proprietary flow from design to delivery
- Optimized flow for small to medium quantities
- Package assembly performed in an automotive IATF 16949-certified plant
- Radiation hardness characterized by design and monitored early in production through sampling (TNID).

3 Simplified LEO power discrete component manufacturing and control

Table 2. AEC-Qxxx modified manufacturing and control steps for LEO discrete components

Manufacturing step	Item	Description	Reference
Production control	Electrical wafer sort	100 % electrical test with PAT / SBL / SYL	As per ST specification, IATF-16949, AEC-Q001 and Q002
	Visual die test	Optical inspection By sampling, AQL = 0.65 %, S3	As per ST specification
	Visual mounting inspection	Frame-die-clip or bonding before molding By sampling, AQL = 0.25 %, C = 0, level 1	As per ST specification
	Molding	Epoxy resin	As per ST specification
	Assembly process monitoring	SPC lot data collection	ST specification, AIAG SPC
Production screening	Temperature cycling in line	100 % production ,10 cycles -55 to +150 °C	As per AEC-Q101
	IR reflow	Soldering test, by sampling	As per AEC-Q101 / J-STD-020
	Package integrity	100 % production, optical inspection	ST specification, MIL-STD883C
	Final parametric test	100 % production, according to datasheet	As per ST specification
Wafer lot acceptance WLAT	Wafer lot process monitoring	SPC lot data collection	ST specification, AIAG SPC
	Reliability	1000 hours, HTRB, by sampling	MIL-STD-750 method 1038A
	Parametric characterization	Include temperature test, by sampling	ST operation procedure
	Total nonionizing dose (TNID)	3.1011 protons / cm^2 Early-stage production monitoring	ESCC22500
Quality insurance	Reel filling	1 date code per reel	Linked to LEO classification
	Order entry	Max. one wafer lot per order Max. two assembly lots per order	Linked to LEO classification
	Data storage	10 years	Linked to LEO classification
	Package use warranty	5 years	Linked to LEO classification

4 LEO power discrete product versions

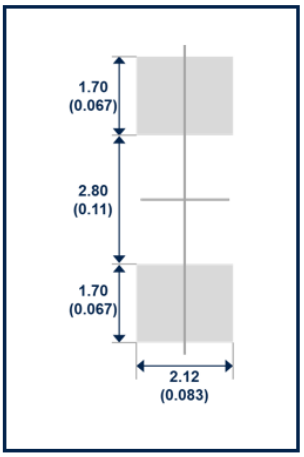
Table 3. Product versions

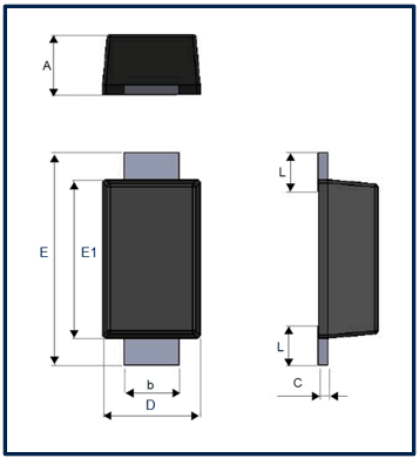
Version	Specification	Ordering code
Flight model	Qualified as per “ST LEO generic specification” Delivered with certificate of conformance (CoC) Maximum useable date code: 5 years Marking: Part number extrapolation (ex: 5811L, 5819L) Packing: Tape and Reel	LEO1N5811AF LEO1N5819AF LEO1N5822AF
Development samples	Qualified as per “ST LEO Generic Specification” No Certificate of Conformance (CoC) delivered Maximum useable date code: 5 years Marking: Part number extrapolation (ex: 5811L, 5819L)	Same as flight model

5 Package information

Figure 3. **SOD128Flat package information**

SOD128Flat			
mm unit	MIN.	TYP.	MAX.
A	0.93	0.98	1.03
b	1.69		1.81
c	0.1		0.22
D	2.3	2.40	2.5
E	4.6	4.7	4.8
E1	3.7		3.9
L	0.55		0.85
Area			12





6 Documentation for LEO power discrete components

Available documents

- Datasheet, on the ST website
- Material declaration form (MDF), on the ST website
- Certificate of conformance (CoC), on each delivery
- Change or termination notifications (PCN/PTN) related to change and termination of products
- Qualification report and construction analysis, on-demand under non-disclosure agreement
- Wafer lot acceptance test report, only during audit under non-disclosure agreement.

Certificate of conformance (CoC) content

Table 4. Certificate of conformance documentation

Certificate of conformance documentation
• Customer name
• Customer purchase order number
• ST order confirmation number
• ST part number
• Product marking
• Delivered quantity
• Product date code
• Wafer lot number and manufacturing location
• Detail specification–Product datasheet
• Generic specification reference
• Radiation validation test (RVT) report reference
• Wafer lot acceptance report reference, including references of: – Assembly statistical process control (SPC) report – Wafer lot characterization report – Wafer lot reliability report

Qualification report content

- Reliability overview
- Device characteristics with descriptions and construction notes
- Reliability test descriptions and results.

7 Conclusion

This note provides key information on the low Earth orbit (LEO) qualification and process flows dedicated to the "New Space" components.

These flows integrate the best practices of the automotive and aerospace manufacturing capabilities available at STMicroelectronics to offer satellite designers and manufacturers a smaller footprint, reduced total cost of ownership, and improved quality assurance.

Additionally, they ensure radiation hardness and support large-scale production capacity.

Appendix A Glossary

Acronyms	Description
AEC	Automotive electronics council
BE	Back-end package assembly manufacturing
FE	Front-end diffusion manufacturing
CDM	Electrostatic discharge–Charged device model
CoC	Certificate of conformance
CVCM	Collected volatile condensable material
ESD	Electrostatic discharge
HBM	Electrostatic discharge - Human body model
UHAST	Unbiased highly accelerated stress test
HTRB	High temperature reverse bias test
H3TRB	High humidity high temperature bias test
IOLT	Intermittent operating life test
IATF	International standard for automotive quality management systems
MDF	Material declaration form
MSL	Moisture sensitivity level
PAT	Part average testing (static, dynamic or geographic)
PCN	Product change notification
PTN	Product termination notification
RVT	Radiation validation test
RML	Recovered mass loss
CSAM	Confocal scanning acoustic microscopy
SAM	Scanning acoustic microscopy
XRAY	X-ray inspection
SEL	Single event latch-up
SEB	Single event burn-out
TC	Thermal cycling test
WBP	Wire bond pull
WBS	Wire bond shear
WLAT	Wafer lot acceptance test

Revision history

Table 5. **Document revision history**

Date	Revision	Changes
11-Aug-2025	1	Initial release.

Contents