



AHEAD OF WHAT'S POSSIBLE™

COMMERCIAL SPACE LEVEL PRODUCTS PROGRAM

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For general information on Analog Devices Space Qualified products please visit the following address.

<http://www.analog.com/aerospace>

For technical inquiries on Aerospace Models please email us at aero@analog.com

For Sales and Distribution contacts please visit the following address.

<http://www.analog.com/en/about-adi/corporate-information/sales-distribution.html>

ANALOG DEVICES STANDARD COMMERCIAL SPACE LEVEL PRODUCTS PROGRAM

The electronic content of satellites is expanding exponentially in both traditional GEO satellite signal processing applications as well as LEO small satellite constellations that will provide internet access from any point on the planet. These new ambitious design solutions require reduced size, weight, power and cost. The benefits of using Plastic Encapsulated Microcircuits (PEMs) or Commercial-Off-The-Shelf devices (COTS) in space level applications are attractive: advanced technologies, higher levels of integration, higher performance, better size, weight, and power specifications. Design engineers in the space industry are tasked with using risk analysis to reduce cost while increasing performance and maintaining system reliability. A given device might be suitable for use in space, but not in all space level applications. The components selected must meet the specific mission requirements. The challenge today is how to implement COTS methodology in space level applications. The goal is to reach an acceptable level of reliability, within the technical, commercial, and financial constraints of the mission. Unfortunately, depending on the specific mission requirements, there are an endless number of possibilities for screening and quality conformance inspections.

There is a wide range of methodologies used for space level device screening and qualification. The traditional approach to assure hi-reliability, is to specify devices that are processed through 100% screening and quality conformance inspection testing. At the other end of the spectrum are commercial grade devices that have not been subjected to any screening. The devices are qualified by a second level burn-in and qualification at the next level board or system level screening and qualification. In order to address the broad range of screening and quality conformance inspection requirements demanded by these new space level applications, Analog Devices has established three commercial space product screening and qualification flows. The flows are designed to offer the best price/reliability ratio for applications not requiring the highest level of product assurance and reliability.

- The Commercial Space Light (**CSL**) process flow addresses the low cost, high volume requirements with minimal testing and screening for application like LEO constellations. CSL devices offer one assembly/test/fabrication site for wafer lot traceability. This provides the customer a homogeneous lot in order to perform any additional program specific mission screening or inspection testing that may be required.
- The Commercial Space Medium (**CSM**) screening and qualification flow is offered for longer mission life requirements that demand an enhanced level of component reliability.
- The Commercial Space High (**CSH**) flow offers the highest screening and qualification level. This product qualification flow offers the leading-edge technology utilizing PEMs devices for fast time to market. Negating the need for long lead time hermetic package development and subsequent electrical characterization due to a new set of package parasitics.

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What are Commercial Space Products?

- Commercial Space products bridge the gap between commercial products and full space qualified hermetic QML V product.
- Decades of knowledge building space grade parts is being applied to make commercial parts suitable for space use.
- Three product grades address the emerging and wide-ranging needs;
 - **CSL** - Low cost, high volume requirements - minimal testing and screening for LEO constellations.
 - **CSM** - Longer missions / single satellites or small constellations requiring enhanced level of product screening.
 - **CSH** - Highest screening and qualification level, used where no hermetic-package option is available (equivalent to QML V using SAE AS6294 as a guideline).

Why not just use commercial plastic components in space?

- It is a matter of balancing confidence in operating reliability with cost to reach an acceptable level of risk.
- Wafer lot uniformity and traceability, radiation monitors and enhanced testing/screening are not supported with commercial product.

Analog Devices Commercial Space device screening and qualification is based on an internally defined equivalent flows per NASA PEM-INST-001 and SAE AS6294 except as noted herein.

The electrical parameters and end points for the Analog Devices Standard Commercial Space devices will be as described in the current Analog Devices Space Level datasheets for each standard device offered.

Features of Analog Standard Commercial Space Program Includes the following:

CSL Features:

1. Single Wafer Fabrication location
2. Wafer lot uniformity and traceability
3. Radiation monitors
4. Product Change Notification

CSM and CSH Features:

1. Single Wafer Fabrication location
2. Wafer lot uniformity and traceability
3. Radiation monitors
4. High reliability Screening
5. High reliability Quality Conformance Inspection
6. Product Change Notification

COMMITMENT TO THE SPACE MARKET

For over 50 years Analog Devices has been at the forefront of innovation for Aerospace and Defense applications. ADI's commitment to performance, reliability and sustainability has made ADI a preferred supplier to the Department of Defense (DoD) and other US and foreign Aerospace and defense agencies around the world. ADI is leading the way in many of the key initiatives currently facing the Aerospace and Defense industry.

Today's advanced Aerospace and Defense systems in radar, communications, avionics, defense electronics and much more demand the best in system level performance. We leverage our IC design capabilities

to select the optimum device technologies for these applications. We employ internal resources for engineering, prototyping and production assembly/test. High reliability screening is offered for all products to customer specifications and / or governing standards requirements. ADI's superior products, expanded product portfolio and system level knowledge will help you overcome the most difficult of design challenges.

Visit our web site (<http://www.analog.com/aerospace>) or call our factory contacts for the latest Commercial Space updates as well as for radiation information on these and other products.

For further information see contact list on cover page.

ANALOG DEVICES STANDARD COMMERCIAL SPACE PRODUCTS PROGRAM MANUFACTURING LOCATIONS

Space Level Screening	Wafer Fab	Assembly	Screening and Quality Conformance Inspection
Standard Commercial Space Product device screening and qualification	<ul style="list-style-type: none"> • ADI Wilmington, MA • ADI Limerick, Ireland • ADI Camus, WA • TSMC Taiwan • Various Foundries 	<ul style="list-style-type: none"> • ADI Penang, Malaysia • Various ADI approved Subcontractors 	<ul style="list-style-type: none"> • ADI Cavite, Philippines • ADI Chelmsford, MA • ADI Milpitas, CA

ANALOG DEVICES STANDARD COMMERCIAL SPACE SCREENING FLOWS

Screen / Test	Test Method / Requirements	CSL	CSM	CSH	Notes
Wafer Fabrication	Single fab location	X	X	X	
Wafer Lot Acceptance Test	SEM analysis			X	
Assembly	Per commercial flow with single diffusion lot per assembly lot, provide traceability	X	X	X	Nickle Palladium Gold conversion or dip an option
Operating Temp Range	Extend operating temperature range through qualification and performance testing			X	CSL, CSM use best commercially available
Pre-cap Source Inspection		N/A	N/A	N/A	
Serialization				X	Where package size permits laser mark or register options
Destructive Physical Analysis (DPA)	Based on MIL-STD-1580, requirement 16. Sample size greater of 2% or 5pcs, but not to exceed 30pcs per lot.			X	Tests and lab requirements determined by QA, N/A for hermetic packages
Gross Bubble Test		N/A	X	X	Air cavity packages only
Fine/gross Leak Test	MIL-STD 883, TM 1014.A & C	N/A	N/A	N/A	
External Visual Inspection	MIL-STD 883, TM 2009		X	X	
Thermal Cycle	MIL-STD-883, TM 1010.B, 20 cycles or equivalent		X	X	
Radiographic	MIL-STD-883, TM 2012 (top view) and inspect for wire sweep		X	X	
Constant Acceleration	MIL-STD-883, TM 2001.E, Y1 Axis only			X	Air cavity packages only
C-SAM	MIL-STD 883, TM 2030		X	X	N/A to air cavity packages
PIND	MIL-STD 883, TM 2020.A		X	X	Air cavity packages only
Pre-burn-in Electrical Tests	100% of the devices per device specification at room temperature	X	X	X	
Burn-in	100% of devices for <116pcs lot size, >=116 pcs randomly select 116 samples from each flight lot and perform burn-in per MIL-STD-883, TM 1015 (160 hours @ 125°C, or equivalent, with DC bias)		X		Single pass burn-in condition as determined by ADI. Conditions may vary by device
	100% of devices from each flight lot and perform burn-in per MIL-STD-883, TM 1015 (240 hours @ 125°C, or equivalent, with DC bias), for lots >500pcs a sampling plan will be agreed upon			X	
Final Electrical Tests	Perform 100% electrical test (at min, room and max temperatures) on all burn-in units		X	X	
Deltas Calculation	Per datasheet specs, performed on all burn-in units, calculated as a <u>lot average delta</u> .		X		
	Per datasheet specs, performed on all burn-in units.			X	

ANALOG DEVICES STANDARD COMMERCIAL SPACE SCREENING FLOWS Cont.

Screen / Test	Test Method / Requirements	CSL	CSM	CSH	Notes
Percent Defective Allowable (PDA)	5% max, repeat burn-in <10%, 2nd pass <2%		X	X	
External Visual Inspection	MIL-STD 883, TM 2009		X	X	
Gross Bubble Test		N/A	X	X	Air cavity packages only
Fine/gross Leak Test	MIL-STD 883, TM 1014.A & C	N/A	N/A	N/A	
External Visual Inspection	ADI0028	X	X	X	
Test Report			X	X	Option at additional cost
C of C	With diffusion lot traceability information	X	X	X	Follows current ADI QA major change PCN guidelines

COMMERCIAL SPACE QUALITY CONFORMANCE INSPECTION

Screen / Test	Test Method / Requirements	CSL	CSM	CSH	Notes
Visual Inspection and Serialization			X (22)	X (37)	Where package size permits, laser mark or register options
Baseline C-SAM	MIL-STD-883, TM 2030			X	
Preconditioning	Moisture soak per JESD22-A113			X	
Solderability	MIL-STD 883, TM 2003		X	X	5 samples
Electrical Test	100% of the devices per device specification at min, room, & max temperatures		X	X	

COMMERCIAL SPACE QUALITY CONFORMANCE INSPECTION Cont.

Group 1: 10 samples for CSM, 16 samples for CSH from the 116pcs production test					
Screen / Test	Test Method / Requirements	CSL	CSM	CSH	Notes
Physical Dimensions	MIL-STD-883, TM 2016		X	X	
Steady State Life Test	MIL-STD-883, Method 1005, 500 hrs at +125°C		X		Condition based on product type
	MIL-STD-883, Method 1005, 1,000 hrs at +125°C			X	
	Additional 1000 hrs			X	Information only
Thermal Cycle	MIL-STD-883, TM 1010.B, 100 cycles or equivalent		X		
	MIL-STD-883, TM 1010.B, 500 cycles or equivalent			X	
C-SAM	MIL-STD-883, TM 2030			X	
Post Burn-in Electrical Test	100% of devices per device specification at min, room, & max temperatures		X	X	
Destructive Physical Analysis (DPA)	Based on MIL-STD-1580			X	Tests and lab requirements determined by QA, N/A for hermetic packages
External Visual Inspection	MIL-STD-883, TM 2009, indentation in metalization and/or copper base metal may be exposed through Sn/Pb plating after processing and shall not be grounds for rejection if caused by fixturing and no other visual acceptance criteria are violated.		X	X	
Group 2: 7 samples for CSM, 16 samples for CSH from the 116pcs production test					
Unbiased HAST	JESD22-A118, 96hours, 130°C @ 85% RH		X	X	N/A to air cavity packages
Electrical Test	100% of the devices per device specification at min, room, & max temperatures		X	X	N/A to air cavity packages
External Visual Inspection	MIL-STD 883, TM 2009		X	X	

COMMERCIAL SPACE RADIATION INSPECTION

Radiation Analysis					
TID Radiation Benchmark	TID to 30Krad at 0.01Rads/s dose rate, pass fail to data sheet specification, perform once before product release only, as required by process	X	X		Generic report
TID Wafer Specific Test	TID to 30Krad at 0.01Rads/s dose rate, pass fail to data sheet specification, using samples from same wafer used for production build, as required by process		X		Option at additional cost, no lot jeopardy
TID Radiation Lot Acceptance Test (RLAT)	TID specified per datasheet at 0.01Rads/s dose rate, as required by process			X	Data provided in Test Report
SEE Benchmark	SEL, perform once at initial qualification, as required by process, optional		X		Generic report
	SEL, perform once at initial qualification, as required by process			X	

1. When required, test reports will include:
 - A. 100% processing attributes data
 - B. Electrical test variable data, if applicable
 - C. Radiographic inspection report, if applicable
 - D. Failure analysis report, if applicable
 - E. Group A attributes data, if applicable
 - F. Certificate of Conformance