



# ADI Commercial Space Products Program

2023

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The electronic content of satellites is expanding exponentially in both traditional GEO satellite signal processing applications and LEO small satellite constellations. 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 include advanced technologies, higher levels of integration, higher performance, and better size, weight, and power specifications.

## What Are Commercial Space Products?

Commercial space bridges 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.

ADI has created two new product grades to address the emerging and wide-ranging needs:

- ▶ **CSL**—Cost-constrained or high-volume requirements: basic testing and screening suitable for LEO constellations.
- ▶ **CSH**—Highest screening and qualification level, used where no hermetic-package option is available (equivalent to QML-V using SAE AS6294 as a guideline).

Balancing reliability with cost to reach an acceptable level of risk is of utmost importance in the era of new space. Features such as wafer lot uniformity and traceability, radiation monitors, and enhanced testing/screening that are not supported with a commercial-grade product.

ADI's commercial space device screening and qualification is based on internally defined equivalent flows per NASA PEM-INST-001 and SAE AS6294.

### CSL Features:

- ▶ Wafer lot uniformity and traceability
- ▶ Radiation monitors
- ▶ Outgassing characterization
- ▶ High reliability lead finishes and no Cu wire bonds
- ▶ Extended temperature

### CSH Features:

- ▶ Everything offered with CSL, plus ...
- ▶ High reliability screening
- ▶ High reliability Quality Conformance Inspection

### CSH Data Reports

Data reports are included for CSH products, and include the following:

- ▶ 100% processing attributes data
- ▶ Electrical test variable data, if applicable
- ▶ Radiographic inspection report, if applicable
- ▶ Failure analysis report, if applicable
- ▶ Certificate of Conformance

### 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"> <li>▶ ADI Wilmington, MA</li> <li>▶ ADI Limerick, Ireland</li> <li>▶ ADI Camas, WA</li> <li>▶ Various foundries</li> </ul>	<ul style="list-style-type: none"> <li>▶ ADI Penang, Malaysia</li> <li>▶ Various ADI approved subcontractors</li> </ul>	<ul style="list-style-type: none"> <li>▶ ADI Cavite, Philippines</li> <li>▶ ADI Chelmsford, MA</li> <li>▶</li> </ul>

### Commercial Space Screening Flows

Screen/Test	Test Method/Requirements	CSL	CSH	Notes
<b>Wafer fabrication</b>	Single fab location	X	X	
<b>Wafer lot acceptance test</b>	SEM analysis, as required by process		X	
<b>Assembly</b>	Hi-Rel package finish (nickel palladium gold preferred), if available, and no Cu wire bonds	X	X	No matte tin except where noted
<b>Outgas characterization</b>	ASTM E-595	X	X	Performed once per released assembly BOM
<b>Operating temperature range</b>	Extend operating temperature range from -55°C to +125°C through qualification and performance testing, subject to device limitations	X	X	
<b>Pre-cap source inspection</b>		N/A	N/A	
<b>Serialization</b>	Laser mark or embedded memory options, where package size permits		X	
<b>Gross bubble test</b>		N/A	X	Air cavity packages only
<b>Fine/gross leak test</b>	MIL-STD-883, TM 1014 Cond A & C	N/A	N/A	
<b>External visual inspection</b>	Per ADI0028 External Visual		X	ADI0485 for hermetic

Screen/Test	Test Method/Requirements	CSL	CSH	Notes
<b>Thermal cycle</b>	MIL-STD-883, TM 1010 Cond B, 20 cycles or equivalent		X	
<b>C-SAM</b>	J-STD-020		X	N/A to air cavity packages
<b>Radiographic</b>	MIL-STD-883, TM 2012 (top view) and inspect for wire sweep		X	
<b>Constant acceleration</b>	MIL-STD-883, TM 2001 Cond E, Y1 axis only		X	Air cavity packages only
<b>PIND</b>	MIL-STD-883, TM 2020 Cond A		X	Air cavity packages only
<b>Pre-burn-in electrical tests</b>	100% of the devices per device specification at room temperature	X	X	
<b>Burn-in</b>	100% of devices from each flight lot and perform burn-in per MIL-STD-883, TM 1015 (240 hours at Tcase = 125°C). For lots >500 pcs, a sampling plan can be considered.		X	Tcase dependent on product type. Single pass burn-in condition as determined by ADI; conditions may vary by device
<b>Final electrical tests</b>	Perform 100% electrical test (at min, room, and max temperatures) on all burn-in units		X	
<b>Deltas calculation</b>	Per data sheet specs, performed on all burn-in units		X	When serialization not possible, delta calculation based on Min vs Max from each subplot
<b>Percent defect allowable (PDA)</b>	5% max, repeat burn-in <10%, second pass <3%		X	
<b>Gross bubble test</b>		N/A	X	Air cavity packages only
<b>Fine/gross leak test</b>	MIL-STD-883, TM 1014 Cond A & C	N/A	N/A	
<b>External visual inspection</b>	Per ADI0028 External Visual	X	X	
<b>Destructive physical analysis (DPA)</b>	Based on NASA PEM-INST-001; 5 samples		X	Tests and lab requirements determined by QA, N/A for hermetic packages
<b>Data report</b>			X	
<b>Diffusion Lot traceability</b>	Listed on box label	X	X	
	Included in C of C		X	Follow current ADI QA major changes PCN guidelines

### Commercial Space Quality Conformance Inspection

Screen/Test	Test Method/Requirements	CSL	CSH	Notes
<b>Visual inspection and serialization</b>	Per ADI0028 or ADI0485 for hermetic in test method/conformance		X	Where package size permits, laser mark or register options
<b>Baseline C-SAM</b>	J-STD-020		X	C-SAM is N/A for Air cavity packages
<b>Preconditioning</b>	Moisture soak per JESD22-A113		X	
<b>Solderability</b>	MIL-STD-883, TM 2003 or J-STD-002		X	5 samples at additional cost, based on package type. Steam aging is not required for plastic packages
<b>Electrical test</b>	100% of the devices per device specification at min, room, and max temperatures		X	
<b>Group 1: 16 samples per CSH wafer diffusion lot</b>				
<b>Physical dimensions</b>	MIL-STD-883, TM 2016		X	
<b>Steady state life test</b>	MIL-STD-883, TM 1005, 1,000 hrs at Tcase = +125°C		X	Tcase dependent on product type. Life test conditions determined by ADI, conditions may vary based on product type
	Additional 1000hrs		X	Information only, can use sub data
<b>Post burn-in electrical test</b>	100% of devices per device specification at min, room, and max temperatures		X	Tested at 1000hrs and 2000hrs life test. Electrical test performed at room temperature only if sub-data is used
<b>External visual inspection</b>	Per ADI0028 External Visual, indentation in metallization and/or copper base metal may be exposed through plating after processing and shall not be grounds for rejection if caused by fixturing and no other visual acceptance criteria are violated		X	ADI0485 for hermetic
<b>Group 1a: 16 samples per CSH package assembly lot</b>				
<b>Thermal cycle</b>	MIL-STD-883, TM 1010 Cond B, 500 cycles or equivalent		X	
<b>Post burn-in electrical test</b>	100% of devices per device specification at min, room, & max temperatures		X	
<b>C-SAM</b>	J-STD-020		X	

<b>External Visual Inspection</b>	Per ADI0028		X	ADI0485 for hermetic
<b>Group 2: 16 samples per CSH package assembly lot</b>				
<b>Unbiased HAST</b>	JESD22-A118, 96 hrs, 130°C at 85% RH		X	N/A to air cavity packages
<b>Electrical test</b>	100% of the devices per device specification at min, room, and max temperatures		X	N/A to air cavity packages
<b>External visual inspection</b>	Per ADI0028 External Visual		X	ADI0485 for hermetic

**Commercial Space Radiation Inspection**

Screen/Test	Test Method/Requirements	CSL	CSH	Notes
<b>TID wafer lot specific test</b>	TID up to 30 Krads per data sheet specification, using samples from same wafer lot used for production build, as required by process	X		Generic radiation report
<b>TID radiation lot acceptance test (RLAT)</b>	TID specified per data sheet, pass/fail to data sheet specification (post rad limits), as required by process		X	
<b>SEE benchmark</b>	SEL performed once at initial qualification, repeated for any major process or mask change, as required by process	X*	X	Generic report *Optional at addition cost