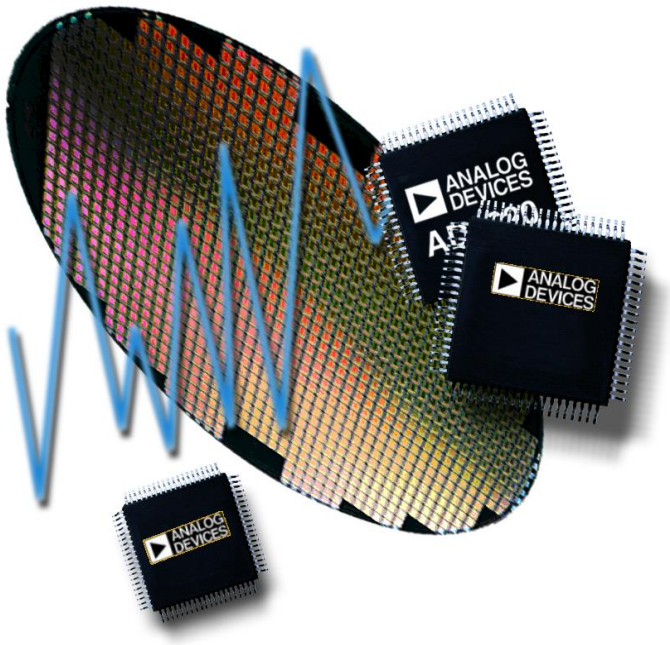


# Reliability Report

**Report Title:** 0.6um CMOS Wafer Fabrication for Amplifier Product at ADI Limerick Fab Qualification

**Report Number:** 20900

**Revision:** A

**Date:** 26 April 2023

## Summary

This report documents the reliability qualification requirements for the release of the 0.6um CMOS Wafer Fabrication Process for Amplifier Product in Analog Devices Limerick Wafer Fabrication Facility. The products listed below were selected to cover the technology being released.

The products are:

The AD8648 product in a 14-TSSOP_4.4 package is a quad, rail-to-rail, input and output, single-supply amplifier featuring low offset voltage, wide signal bandwidth, low input voltage, and low current noise.

The AD8694 product in a 14-TSSOP_4.4 package is a low cost, quad rail-to-rail output, single-supply amplifiers featuring low offset and input voltages, low current noise, and wide signal bandwidth.

## AECQ100 Qualification Test Methods and Summary

| AEC Test Group | AEC Stress Test Name | Abbreviation | AEC Test # | Reference |
|---|---|---|---|---|
| **Group A** ACCELERATED ENVIRONMENT STRESS TESTS | Preconditioning | PC | A1 | Table 2 and Table 4 |
| | Temperature Humidity Bias or Biased-HAST | THB or HAST | A2 | |
| | Autoclave or Unbiased HAST or Temperature Humidity (without Bias) | AC, UHST, or TH | A3 | |
| | Temperature Cycle | TC | A4 | |
| | Power Temperature Cycling | PTC | A5 | |
| | High Temperature Storage Life | HTSL | A6 | |
| **Group B** ACCELERATED LIFETIME SIMULATION TESTS | High Temperature Operating Life | HTOL | B1 | Table 2 and Table 4 |
| | Early Life Failure Rate | ELFR | B2 | |
| | NVM Endurance, Data Retention, and Operational Life | EDR | B3 | |
| **Group C** PACKAGE ASSEMBLY INTEGRITY TESTS | Wire Bond Shear | WBS | C1 | • Test C2 (and C1 for Cu Wire) are shown in Table 4.<br>• Tests C3-6 are qualified and controlled with inline monitors and may be viewed on-site at Analog Devices. |
| | Wire Bond Pull Strength | WBP | C2 | |
| | Solderability | SD | C3 | |
| | Physical Dimensions | PD | C4 | |
| | Solder Ball Shear | SBS | C5 | |
| | Lead Integrity | LI | C6 | |
| **Group D** DIE FABRICATION RELIABILITY TESTS | Electromigration | EM | D1 | Die Fabrication Reliability data may be viewed on-site at Analog Devices. |
| | Time Dependent Dielectric Breakdown | TDDB | D2 | |
| | Hot Carrier Injection | HCI | D3 | |
| | Negative Bias Temperature Instability | BTI | D4 | |
| | Stress Migration | SM | D5 | |
| **Group E** ELECTRICAL VERIFICATION TESTS | Pre- and Post-Stress Electrical Test | TEST | E1 | Table 5 and Table 6 |
| | Electrostatic Discharge Human Body Model | HBM | E2 | |
| | Electrostatic Discharge Charged Device Model | CDM | E3 | |
| | Latch-Up | LU | E4 | |
| | Electrical Distributions | ED | E5 | • For Tests E5, E6 and E7, ADI New Product Yield Analysis Testing Guidelines meet AEC Q100 requirements.<br>• Results for Tests E7-E11 are available as applicable on a case by case basis.<br>• Test E12 results may be viewed on-site at Analog Devices |
| | Fault Grading | FG | E6 | |
| | Characterization | CHAR | E7 | |
| | Electromagnetic Compatibility | EMC | E9 | |
| | Short Circuit Characterization | SC | E10 | |
| | Soft Error Rate | SER | E11 | |
| | Lead (Pb) Free | LF | E12 | |
| **Group F** DEFECT SCREENING TESTS | Process Average Test | PAT | F1 | ADI New Product Yield Analysis Testing Guidelines meet AECQ100 Requirements. |
| | Statistical Bin/Yield Analysis | SBA | F2 | |
| **Group G** CAVITY PACKAGE INTEGRITY TESTS | Mechanical Shock | MS | G1 | <Applicable only for Cavity Packages> |
| | Variable Frequency Vibration | VFV | G2 | |
| | Constant Acceleration | CA | G3 | |
| | Gross/Fine Leak | GFL | G4 | |
| | Package Drop | DROP | G5 | |
| | Lid Torque | LT | G6 | |
| | Die Shear | DS | G7 | |
| | Internal Water Vapor | IWV | G8 | |

## Die/Fab Product Characteristics

**Table 1: Die/Fab Product Characteristics- 0.6um CMOS**

| Product Characteristics | Product(s) to be qualified | |
|---|---|---|
| Generic/Root Part # | AD8648/8YX12A | AD8694/8YL18C |
| Die Id | 6535Y | 6526z |
| Die Size (mm) | 1.445 x 2.090 | 1.455 x 1.335 |
| Wafer Fabrication Site | ADI-Limerick | ADI-Limerick |
| Wafer Fabrication Process | 0.6um CMOS | 0.6um CMOS |
| Die Substrate | Si | Si |
| Metallization / # Layers | AlCu(0.5%)/2 | AlCu(0.5%)/2 |
| Polyimide | Yes | Yes |
| Passivation | undoped-oxide/SiN | undoped-oxide/SiN |

## Die/Fab Test Results

**Table 2: Die/Fab Test Results - 0.6um CMOS at ADI-Limerick**

| Test Name | AEC # | Spec | Conditions | Generic/Root Part # | Lot # | Fail/SS | eTest Temp |
|---|---|---|---|---|---|---|---|
| High Temperature Storage Life (HTSL) | A6 | JESD22-A103 | 150°C, 1,000 Hours | AD8648 | Q20329.1.HS1_RES | 0/77 | RH |
| High Temperature Operating Life (HTOL) | B1 | JESD22-A108 | 125°C<Tj<135°C, Biased, 500 Hours | AD8648 | Q20329.1.HO1_RES | 0/77 | RHC |
| | | | | | Q20329.2.HO2_RES | 0/77 | RHC |
| | | | | | Q20329.3.HO3_RES | 0/77 | RHC |
| Temperature Cycling (TC)[1] | A4 | JESD22-A104 | -65°C/+150°C, 500 Cycles | AD8648 | Q20329.1.TC1_RES | 0/77 | H |
| | | | | | Q20329.2.TC2_RES | 0/77 | H |
| | | | | | Q20329.3.TC3_RES | 0/77 | H |
| | | | | AD8694 | Q20385.1.TC1_RES | 0/77 | H |
| | | | | | Q20385.2.TC2_RES | 0/77 | H |
| Unbiased HAST (UHST)[1] | A3 | JESD22-A118 | 130C 85%RH 33.3 psia, 96 Hours | AD8648 | Q20329.1.UH1_RES | 0/77 | R |
| | | | | | Q20329.2.UH2_RES | 0/77 | R |
| | | | | | Q20329.3.UH3_RES | 0/77 | R |
| Highly Accelerated Temperature and Humidity Stress Test (HAST)[1] | A2 | JESD22-A110 | 130C 85%RH 33.3 psia, Biased, 96 Hours | AD8648 | Q20329.1.HA1_RES | 0/77 | RH |
| | | | | | Q20329.2.HA2_RES | 0/77 | RH |
| | | | | | Q20329.3.HA3_RES | 0/77 | RH |
| | | | | AD8694 | Q20385.1.HA1_RES | 0/77 | RH |
| | | | | | Q20385.2.HA2_RES | 0/77 | RH |

[1] These samples were subjected to preconditioning at MSL 1 with 3x reflow peak temp of 260°C prior to the start of the stress test.

## Package/Assembly Product Characteristics

**Table 3: Package/Assembly Product Characteristics - 14-TSSOP_4.4 at AMKOR (AP1)**

| Product Characteristics | Product(s) to be qualified | |
|---|---|---|
| Generic/Root Part # | AD8648 | AD8694 |
| Package | 14-TSSOP_4.4 | 14-TSSOP_4.4 |
| Body Size (mm) | 5.00 x 4.40 x 1.00 | 5.00 x 4.40 x 1.00 |
| Assembly Location | AMKOR (AP1) | AMKOR (AP1) |
| MSL/Peak Reflow Temperature(°C) | 1 / 260°C | 1 / 260°C |
| Mold Compound | Sumitomo G700K | Sumitomo G700K |
| Die Attach | Ablestik 8290 conductive | Ablestik 8290 conductive |
| Leadframe Material | Copper | Copper |
| Lead Finish | 100Sn | 100Sn |
| Wire Bond Material/Diameter (mils) | Gold / 1.00 | Gold / 1.00 |

## Package/Assembly Test Results

**Table 4: Package/Assembly Test Results - TSSOP_4.4 at AMKOR (AP1)**

| Test Name | AEC # | Spec | Conditions | Generic/Root Part # | Lot # | Fail/SS | eTest Temp |
|---|---|---|---|---|---|---|---|
| High Temperature Storage Life (HTSL) | A6 | JESD22-A103 | 150°C, 1,000 Hours | AD8648 | Q20329.1.HS1_RES | 0/77 | RH |
| Highly Accelerated Temperature and Humidity Stress Test (HAST)[1] | A2 | JESD22-A110 | 130C 85%RH 33.3 psia, Biased, 96 Hours | AD8648 | Q20329.1.HA1_RES | 0/77 | RH |
| | | | | | Q20329.2.HA2_RES | 0/77 | RH |
| | | | | | Q20329.3.HA3_RES | 0/77 | RH |
| | | | | AD8694 | Q20385.1.HA1_RES | 0/77 | RH |
| | | | | | Q20385.2.HA2_RES | 0/77 | RH |
| Temperature Cycling (TC)[1] | A4 | JESD22-A104 | -65°C/+150°C, 500 Cycles | AD8648 | Q20329.1.TC1_RES | 0/77 | H |
| | | | | | Q20329.2.TC2_RES | 0/77 | H |
| | | | | | Q20329.3.TC3_RES | 0/77 | H |
| | | | | AD8694 | Q20385.1.TC1_RES | 0/77 | H |
| | | | | | Q20385.2.TC2_RES | 0/77 | H |
| Unbiased HAST (UHST)[1] | A3 | JESD22-A118 | 130C 85%RH 33.3 psia, 96 Hours | AD8648 | Q20329.1.UH1_RES | 0/77 | R |
| | | | | | Q20329.2.UH2_RES | 0/77 | R |
| | | | | | Q20329.3.UH3_RES | 0/77 | R |

[1] These samples were subjected to preconditioning at MSL 1 with 3x reflow peak temp of 260°C prior to the start of the stress test.

## ESD and Latch-Up Test Results

**Table 5: ESD Test Result**

| ESD Model | Generic/Root Part # | Package | ESD Test Spec | RC Network | Highest Pass Level | Class | eTest Temp |
|---|---|---|---|---|---|---|---|
| FICDM | AD8648 | 14-TSSOP_4.4 | JS-002 | 1Ω, Cpkg | ±1250V | C3 | RH |
| HBM | AD8648 | 14-TSSOP_4.4 | JS-001 | 1.5kΩ, 100pF | ±4000V | 3A | RH |
| FICDM | AD8694 | 14-TSSOP_4.4 | JS-002 | 1Ω, Cpkg | ±1250V | C3 | RH |
| HBM | AD8694 | 14-TSSOP_4.4 | JS-001 | 1.5kΩ, 100pF | ±4000V | 3A | RH |

**Table 6: Latch Up Test Result**

| LU Test Spec | Generic/Root Part # | Passing Current | Passing Over-Voltage | Temperature ($T_A$) | Class | eTest Temp |
|---|---|---|---|---|---|---|
| JESD78 | AD8648 | +200ma, -200ma | +4.125V | 125°C | IIA | RH |
| JESD78 | AD8694 | +200ma, -200ma | +4.125V | 125°C | IIA | RH |

# Approvals

Reliability Engineer: Danilo Juinio Jr.