



Reliability Report

Report Title: 0.35um CMOS Wafer Fabrication at ADI Limerick Fab Qualification

Report Number: 22143

Revision: A

Date: 8 February 2024

Summary

This report documents the reliability qualification requirements for the release of the 0.35um CMOS Wafer Fabrication Process at Analog Devices Limerick Wafer Fabrication Facility. The products listed below were selected to cover the technology being released.

The products are:

The AD1938 is a high performance, single-chip codec that provides four analog-to-digital converters (ADCs) with input and eight digital-to-analog converters (DACs) with single-ended output using the Analog Devices, Inc., patented multibit sigma-delta (Σ - Δ) architecture.

The ADAU1966 is a high performance, single-chip DAC that provides 16 digital-to-analog converters (DACs) with differential output using the Analog Devices, Inc., patented multibit sigma-delta (Σ - Δ) architecture.

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	<ul style="list-style-type: none"> • Test C2 (and C1 for Cu Wire) are shown in Table 4. • 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	TDDDB	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	<ul style="list-style-type: none"> • For Tests E5, E6 and E7, ADI New Product Yield Analysis Testing Guidelines meet AEC Q100 requirements. • Results for Tests E7-E11 are available as applicable on a case-by-case basis. • 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	
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- 0.35um CMOS

Product Characteristics	Product(s) to be qualified	
Generic/Root Part #	AD1938	ADAU1966
Die Id	8YX96A	8YZ08 A
Die Size (mm)	4.11 x 4.92	5.32 x 5.07
Wafer Fabrication Site	I_LIMK0308	I_LIMK0308
Wafer Fabrication Process	0.35um CMOS	0.35um CMOS
Die Substrate	Si	Si
Metallization / # Layers	AlCu(0.5%)/3	AlCu(0.5%)/3
Polyimide	No	No
Passivation	undoped-oxide/SiN	undoped-oxide/SiN

Die/Fab Test Results

Table 2: Die/Fab Test Results - 0.35um 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	AD1938 / 8YX96A	Q21076.1.HS1_RES_EXP	0/77	RH
High Temperature Operating Life (HTOL) ¹	B1	JESD22-A108	125°C<Tj<135°C, Biased, 1000 Hours	AD1938 / 8YX96A	Q21076.1.HO1_RES_EXP	0/77	RHC
					Q21076.2.HO2_RES_EXP	0/77	RHC
					Q21076.3.HO3_RES_EXP	0/77	RHC
Early Life Failure Rate (ELFR)	B2	AEC-Q100-008	Ta=105C, 48 Hours	AD1938 / 8YX96A	Q21076.1.EL1A_RES_EXP	0/800	RH
					Q21076.2.EL2A_RES_EXP	0/800	RH
					Q21076.3.EL3A_RES_EXP	0/800	RH
Temperature Cycling (TC) ¹	A4	JESD22-A104	-65°C/+150°C, 500 Cycles	AD1938 / 8YX96A	Q21076.1.TC1_RES_EXP	0/77	H
					Q21076.2.TC2_RES_EXP	0/77	H
					Q21076.3.TC3_RES_EXP	0/77	H
				ADAU1966 / 8YZ08A	Q21077.1.TC1_RES_EXP	0/77	H
					Q21077.2.TC2_RES_EXP	0/77	H
					Q21077.3.TC3_RES_EXP	0/77	H
Unbiased HAST (UHST) ¹	A3	JESD22-A118	130C 85%RH 33.3 psia, 96 Hours	AD1938 / 8YX96A	Q21076.1.UH1_RES_EXP	0/77	R
					Q21076.2.UH2_RES_EXP	0/77	R
					Q21076.3.UH3_RES_EXP	0/77	R
				ADAU1966 / 8YZ08A	Q21077.1.UH1_RES_EXP	0/77	R
					Q21077.2.UH2_RES_EXP	0/77	R
					Q21077.3.UH3_RES_EXP	0/77	R
Highly Accelerated Temperature and Humidity Stress Test (HAST) ¹	A2	JESD22-A110	130C 85%RH 33.3 psia, Biased, 96 Hours	AD1938 / 8YX96A	Q21076.1.HA1_RES_EXP	0/77	RH
					Q21076.2.HA2_RES_EXP	0/77	RH
					Q21076.3.HA3_RES_EXP	0/77	RH

¹ These samples were subjected to preconditioning at MSL 3 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 - LQFP at STATS (SC3)

Product Characteristics	Product(s) to be qualified	
Generic/Root Part #	AD1938/8YX96A	ADAU1966/8YZ08A
Package	48-LQFP	80-LQFP
Body Size (mm)	7.00 x 7.00 x 1.40	14.00 x 14.00 x 1.40
Assembly Location	STATS (SC3)	STATS (SC3)
MSL/Peak Reflow Temperature(°C)	3 / 260°C	3 / 260°C
Mold Compound	Sumitomo G700E	Sumitomo G700E
Die Attach	Ablestik 3230 conductive	Ablestik 3230 conductive
Leadframe Material	Copper	Copper
Lead Finish	100Sn	100Sn
Wire Bond Material/Diameter (mils)	MKE R 2N Gold / 1.20	MKE R 2N Gold / 1.00

Package/Assembly Test Results

Table 4: Package/Assembly Test Results - LQFP at STATS (SC3)

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	AD1938 / 8YX96A	Q21076.1.HS1_RES_EXP	0/77	RH
Highly Accelerated Temperature and Humidity Stress Test (HAST) ¹	A2	JESD22-A110	130C 85%RH 33.3 psia, Biased, 96 Hours	AD1938 / 8YX96A	Q21076.1.HA1_RES_EXP	0/77	RH
					Q21076.2.HA2_RES_EXP	0/77	RH
					Q21076.3.HA3_RES_EXP	0/77	RH
Temperature Cycling (TC) ¹	A4	JESD22-A104	-65°C/+150°C, 500 Cycles	AD1938 / 8YX96A	Q21076.1.TC1_RES_EXP	0/77	RH
					Q21076.2.TC2_RES_EXP	0/77	RH
					Q21076.3.TC3_RES_EXP	0/77	RH
				ADAU1966 / 8YZ08A	Q21077.1.TC1_RES_EXP	0/77	RH
					Q21077.2.TC2_RES_EXP	0/77	RH
					Q21077.3.TC3_RES_EXP	0/77	RH
Solder Heat Resistance (SHR)	A1	J-STD-020	MSL-3	AD1938 / 8YX96A	Q21076.1.SH1_RES_EXP	0/11	R
					Q21076.2.SH2_RES_EXP	0/11	R
					Q21076.3.SH3_RES_EXP	0/11	R
Unbiased HAST (UHST) ¹	A3	JESD22-A118	130C 85%RH 33.3 psia, 96 Hours	AD1938 / 8YX96A	Q21076.1.UH1_RES_EXP	0/77	R
					Q21076.2.UH2_RES_EXP	0/77	R
					Q21076.3.UH3_RES_EXP	0/77	R
				ADAU1966 / 8YZ08A	Q21077.1.UH1_RES_EXP	0/77	R
					Q21077.2.UH2_RES_EXP	0/77	R
					Q21077.3.UH3_RES_EXP	0/77	R
Wire Bond Pull – Post TC	C2	AEC-Q001	3 gF	AD1938 / 8YX96A	Q21076.1.WP1_RES_EXP	0/5	NA

¹ These samples were subjected to preconditioning at MSL 3 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	AD1938	48-LQFP	AEC Q100-011	1Ω, Cpkg	±1250V	C3	RH
HBM	AD1938	48-LQFP	ANSI/ESDA/JEDEC JS-001-2023	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	AD1938	+150mA, -150mA	+ 5.4V, 5.4V	105°C	II	RH

Approvals

Reliability Engineer: Charles Cabasa

Appendix

Wire Bond Pull Post TCT [WBP Data]

WBP_AD1938W 8YX96A_Q21076.1.WP1_RES_EXP										
Unit	1		2		3		4		5	
Ball	Pull	Mode	Pull	Mode	Pull	Mode	Pull	Mode	Pull	Mode
1	7.51	a-1	12.44	a-1	12.26	a-3	15.43	a-3	14.69	a-1
2	10.40	a-3	6.59	a-3	17.47	a-3	18.13	a-3	17.39	a-3
3	3.88	a-3	11.51	a-3	13.84	a-3	17.08	a-1	9.00	a-3
4	16.48	a-1	4.37	a-3	17.09	a-1	17.55	a-1	13.04	a-2
5	19.54	a-2	15.14	a-1	13.84	a-2	10.76	a-1	11.76	a-1
6	14.56	a-1	17.33	a-3	17.09	a-1	6.65	a-1	19.47	a-1
7	16.94	a-1	12.87	a-3	8.07	a-1	17.37	a-3	8.11	a-1
8	6.29	a-3	12.32	a-1	19.28	a-1	19.7	a-3	6.35	a-1
9	11.78	a-1	9.66	a-3	12.12	a-4	12.69	a-3	16.45	a-3
10	15.28	a-1	4.61	a-3	15.68	a-1	13.8	a-3	10.42	a-1
11	18.79	a-3	7.85	a-3	15.44	a-1	13.74	a-3	4.99	a-1
12	10.09	a-3	11.85	a-3	4.40	a-1	15.56	a-3	5.19	a-2
MIN	3.88		4.37		4.40		6.65		4.99	
MAX	19.54		17.33		19.28		19.70		19.47	
AVE	12.63		10.55		13.88		14.87		11.41	
STDEV	5.09		4.03		4.24		3.63		4.89	