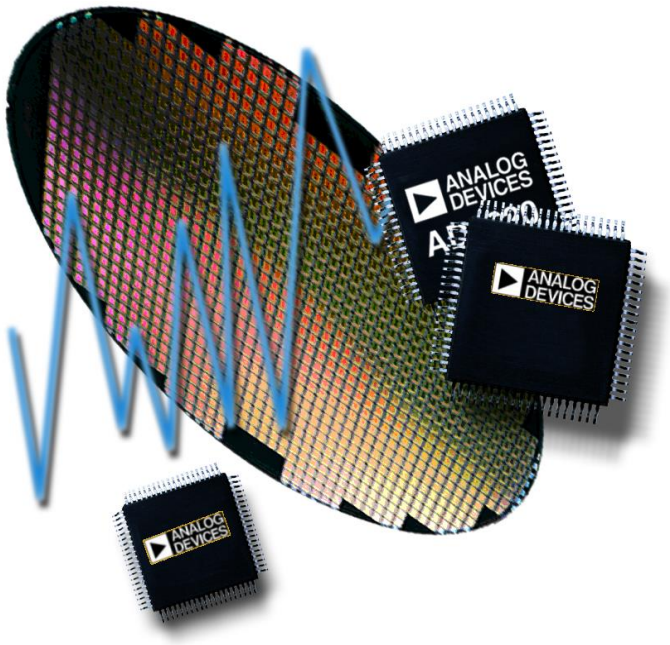

Reliability Report

Report Title: ADXL362W Automotive -20C to 65C Sensor Die Transfer to Wilmington Qualification Report

Report Number: 20408

Revision: A

Date: 14 December 2023

Summary

This report documents the successful completion of the reliability qualification requirements for the release of the ADXL362W product in a 16-LGA package. The ADXL362W is an ultra-low power automotive qualified version of the already released ADXL362. ADXL362W has a sensor die manufactured on the ADI-Wilmington process and a 0.35µm CMOS ASIC from TSMC together in a 16 lead over-molded LGA package assembled in ASE. The operating temperature range of the ADXL362W is -20°C < TA < 65°C.

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. • 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. • 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	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- 0.35um CMOS

Product Characteristics	Product(s) to be qualified	Product(s) used for Substitution Data				
Generic/Root Part #	ADXL362W	ADXL362	ADXRS800	AD189A	AD7150	AD1981B
Die Id	TMDP05 B	XA362A R1	ADXRS800A-DNLAASIC	AD189A	S46B_D	AD1981B
Die Size (mm)	2.45 x 2.4	2.45 x 2.4	2.55x2.89	2.76x2.87	1.52x2.28	3.22x2.75
Wafer Fabrication Site	TSMC Fab-11	TSMC Fab-11	TSMC Fab-11	TSMC Fab-11	TSMC Fab-11	TSMC Fab-11
Wafer Fabrication Process	0.35um CMOS	0.35um CMOS	0.35um CMOS	0.35um CMOS	0.35um CMOS	0.35um CMOS
Die Substrate	Si	Si	Si	Si	Si	Si
Metallization / # Layers	AlCu(0.5%)/4	AlCu(0.5%)/4	AlCu(0.5%)/4	AlCu(0.5%)/4	AlCu(0.5%)/4	AlCu(0.5%)/4
Polyimide	N/A	N/A	Polyimide	Polyimide	Polyimide	Polyimide
Passivation	undoped-oxide/SiN	undoped-oxide/SiN	undoped-oxide/SiN	undoped-oxide/SiN	undoped-oxide/SiN	undoped-oxide/SiN

Table 1.2: Die/Fab Product Characteristics- MEMS

Product Characteristics	Product(s) to be qualified
Generic/Root Part #	ADXL362W
Die Id	XM362
Die Size (mm)	1.33 x 1.19
Wafer Fabrication Site	I_WILM1B08
Wafer Fabrication Process	MEMS
Die Substrate	Si
Metallization / # Layers	AlCu(0.5%)/1
Polyimide	N/A
Passivation	None

Die/Fab Test Results

Table 2.1: Die/Fab Test Results - MEMS at ADI-Wilmington

Test Name	AEC #	Spec	Conditions	Generic/Root Part #	Lot #	Fail/SS	eTest Temp
Powered Mechanical Shock[3]	N/A	IEC 60068-2-27	10,000g, 0.1ms, 5 shock pulses x 6 axes	ADXL362W	Q20408.1.MS1_RES	0/32	R
					Q20408.2.MS2_RES	0/32	R
					Q20408.4.MS3_RES	0/32	R
Group D[1]	G1 G2	MIL-STD-883, M5005	Sub 4, Shock 1500g, Vibration 50g	ADXL362W	Q20408.1.GDBM1_RES	0/39	R
					Q20408.2.GDBM2_RES	0/39	R
					Q20408.3.GDBM3_RES	0/39	R
Group D[2]	G3	MIL-STD-883, M5005	Sub 4, Centrifuge 30kg	ADXL362W	Q20408.1.GDLP1_RES	0/39	R
					Q20408.2.GDLP2_RES	0/39	R
					Q20408.3.GDLP3_RES	0/39	R
Random Drop	G5	AEC-Q100 Test G5	10 drops from 1.2m	ADXL362W	Q20408.1.RD1_RES	0/25	R
					Q20408.2.RD2_RES	0/25	R
					Q20408.3.RD3_RES	0/25	R

[1] Shock and vibration conducted on board mounted parts.
[2] Centrifuge testing conducted on loose parts.
[3] Samples were board mounted to a 16-channel board for the stress test.

Table 2.2: Die/Fab Test Results - 0.35um CMOS at TSMC Fab-11

Test Name	AEC #	Spec	Conditions	Generic/Root Part #	Lot #	Fail/SS	eTest Temp
High Temperature Storage Life (HTSL)	A6	JESD22-A103	150°C, 500 Hours	ADXL362W	Q20408.1.HS1_RES	0/77	RH
					Q20408.2.HS2_RES	0/77	RH
					Q20408.3.HS3_RES	0/77	RH
High Temperature Operating Life (HTOL)[1]	B1	JESD22-A108	85°C, Biased, 1000 Hours	ADXL362W	Q12412.HO1	0/77	RHC
					Q12412.HO2	0/77	RHC
					Q12412.HO3	0/77	RHC
Early Life Failure Rate (ELFR)	B2	MIL-STD-883, M1015	125°C, 48 Hours	AD1895A	Q6604	0/2400	R
				AD7150	F160381.3	0/1600	R
			Ta=105°C, 48 Hours	AD1981B	Q6125	0/1600	R
Early Life Failure Rate (ELFR)	B2	MIL-STD-883, M1015	135°C, 48 Hours	ADXRS800	Q7325	0/1134	RHC
			150°C, 48 Hours		Q8198.16	0/140	RHC
					Q8881	0/3200	RHC

[1] These samples were subjected to preconditioning (per J-STD-020 Level 3) prior to the start of the stress test. Level 3 preconditioning consists of the following: Bake 24 hrs @ 125°C, Soak: Unbiased Soak: 192 hrs @ 30°C, 60%RH, Reflow: 3 passes through an oven with a peak temperature of 260°C.

Package/Assembly Product Characteristics

Table 3: Package/Assembly Product Characteristics - 16-LGA at ASE (AEK)

Product Characteristics	Product(s) to be qualified
Generic/Root Part #	ADXL362W
Package	16-LGA
Body Size (mm)	3.00 x 3.25 x 1.06
Assembly Location	ASE (AEK)
MSL/Peak Reflow Temperature(°C)	3 / 260°C
Mold Compound	Nitto GE 100LFCS
Die Attach/Underfill	Ablestik 2025D non-conductive/Hysol QMI 536 non-conductive
Leadframe Material	BT Resin
Lead Finish	Au
Wire Bond Material/Diameter (mils)	2N Gold / 0.80

Package/Assembly Test Results

Table 4: Package/Assembly Test Results - LGA at ASE (AEK)

Test Name	AEC #	Spec	Conditions	Generic/Root Part #	Lot #	Fail/SS	eTest Temp
Group D[2]	G1 G2	MIL-STD-883, M5005	Sub 4, Shock 1500g, Vibration 50g	ADXL362W	Q20408.1.GDBM1_RES	0/39	R
					Q20408.2.GDBM2_RES	0/39	R
					Q20408.3.GDBM3_RES	0/39	R
Group D[3]	G3	MIL-STD-883, M5005	Sub 4, Centrifuge 30kg	ADXL362W	Q20408.1.GDLP1_RES	0/39	R
					Q20408.2.GDLP2_RES	0/39	R
					Q20408.3.GDLP3_RES	0/39	R
Random Drop	G5	AEC-Q100 Test G5	10 drops from 1.2m, Single Duration	ADXL362W	Q20408.1.RD1_RES	0/25	R
					Q20408.2.RD2_RES	0/25	R
					Q20408.3.RD3_RES	0/25	R
Temperature Humidity Bias (THB)[1]	A2	JESD22-A101	85°C, 85%RH, Biased, 1,000 Hours	ADXL362W	Q20408.1.TH1_RES	0/77	RH
					Q20408.2.TH2_RES	0/77	RH
					Q20408.3.TH3_RES	0/77	RH
High Temperature Storage Life (HTSL)	A6	JESD22-A103	150°C, 500 Hours	ADXL362W	Q20408.1.HS1_RES	0/77	RH
					Q20408.2.HS2_RES	0/77	RH
					Q20408.3.HS3_RES	0/77	RH
Temperature Cycling (TC)[1]	A4	JESD22-A104	-55°C/+125°C, 500 Cycles	ADXL362W	Q20408.1.TC1_RES	0/77	H
					Q20408.2.TC2_RES	0/77	H
					Q20408.3.TC3_RES	0/77	H
Wire Bond Pull	C2	MIL-STD-883, M2011	Post TC Wire Bond Pull Corner Bonds and One Mid Bond Per Side	ADXL362W	Q20408.1.WPPT1_RES	0/10	N/A
Unbiased HAST (UHST)[1]	A3	JESD22-A118	130°C 85%RH 33.3 psia, 96 Hours	ADXL362W	Q20408.1.UH1_RES	0/77	R
					Q20408.2.UH2_RES	0/77	R
					Q20408.3.UH3_RES	0/77	R

[1] These samples were subjected to preconditioning (per J-STD-020 Level 3) prior to the start of the stress test. Level 3 preconditioning consists of the following: Bake 24 hrs @ 125°C, Soak: Unbiased Soak: 192 hrs @ 30°C, 60%RH, Reflow: 3 passes through an oven with a peak temperature of 260°C.

[2] Shock and vibration conducted on board mounted parts.

[3] Centrifuge testing conducted on loose parts.

ESD Test Results

The results of Human Body Model (HBM) and Field-Induced Charged Device Model (FICDM) ESD testing are summarized in Table 5. All parts were electrically tested at room and hot temperatures pre- and post-stress. ADI measures ESD results using stringent test procedures based on the specifications listed. Any comparison with another supplier's results should ensure that the same ESD test procedures have been used. For further details, please see the EOS/ESD chapter of the ADI Reliability Handbook (available via the 'Quality and Reliability' link on Analog Devices' web site).

Table 5: ADXL362W ESD Test Results

ESD Model	Package	ESD Test Spec	RC Network	Highest Pass Level	First Fail Level	Class
FICDM	16-LGA	JESD22-C101	1Ω, Cpkg	±1000V	±1250V	IV
HBM	16-LGA	ESDA/JEDEC JS-001-2011	1.5kΩ, 100pF	±2000V	NA	2

Latch-Up Test Results

Three samples of the ADXL362W were latch-up tested at T_A=85°C per JEDEC Standard JESD78, Class II. Pre- and post-stress electrical test was performed at room (25C) and hot (85C) temperatures. All pins passed.

Passing Positive Current	Passing Negative Current	Passing Over-Voltage
+200mA	-200mA	3.5/V5.25V

Approvals

Reliability Engineer: Michael Walornyj