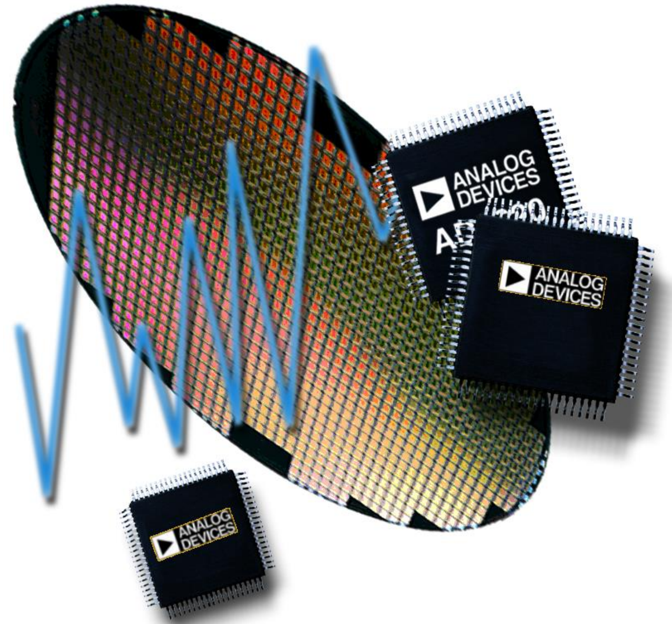

Reliability Report

Report Title: ADXL375/377 Sensor Fab Site Transfer from TSMC to ADWL

Report Number: 19936

Revision: A

Date: 4 April 2023

Summary

This report documents the successful completion of the reliability qualification requirements for the release of the ADXL375 product in a 14-LGA package with XC377 Wilmington only flow MEMS sensor. This qualification also covers the ADXL377 in 16-LFCSP which also uses the XC377 Wilmington only flow MEMS sensor.

The ADXL375 uses the ADXL377 sensor (low power 3-axis accelerometer) paired with the ADXL345 rev D ASIC and packaged in the 14 lead LGA ADXL345.

The ADXL377 is a small, thin, low power, complete 3-axis accelerometer with signal conditioned voltage outputs in a 16 lead LFCSP package.

Die/Fab Product Characteristics

Table 1.1: Die/Fab Product Characteristics- 0.35um CMOS

Product Characteristics	Product(s) to be qualified		Product(s) used for Substitution Data
Generic/Root Part #	ADXL375	ADXL377	ADXL345
Die Id	XA345D	S08D3CS35D17 / A	XA345D
Die Size (mm)	2.25 x 1.45	1.60 x 1.53	2.25 x 1.45
Wafer Fabrication Site	TSMC Fab-11	Magnachip CF-4	TSMC Fab-11
Wafer Fabrication Process	0.35um CMOS	0.35um CMOS	0.35um CMOS
Die Substrate	Si	Si	Si
Metallization / # Layers	AlCu(0.5%)/3	AlCu(0.5%)/3	AlCu(0.5%)/3
Polyimide	No	No	No
Approximate Transistor Count	80,200	80,200	80,200
Passivation	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 #	ADXL375	ADXL377
Die Id	XC377	XC377
Die Size (mm)	1.155 x 1.340	1.155 x 1.340
Wafer Fabrication Site	ADI-Wilmington	ADI-Wilmington
Wafer Fabrication Process	MEMS	MEMS
Die Substrate	Si	Si
Metallization / # Layers	AlCu(0.5%)/1	AlCu(0.5%)/1
Polyimide	No	No
Passivation	None	None

Die/Fab Test Results

Table 2: Die/Fab Test Results for ADXL375/377 MEMS at ADI-Wilmington

Test Name	Spec	Conditions	Generic/Root Part #	Lot #	Fail/SS
Group D	MIL-STD-883, M5005	Sub 4, Shock/Vib/Cent.,	ADXL375	Q19936.1.GD1_RES	0/39
				Q19936.2.GD2_RES	0/39
				Q19936.3.GD3_RES	0/39
PMS	IEC 60068-2-27	10,000g, 5 Shock Pulses, 0.1ms, Single Duration	ADXL375	Q19936.2.MS1	0/10
				Q19936.3.MS2	0/10
				Q19936.4.MS3	0/10
Random Drop	AEC-Q100 Test G5	10 drops from 1.2m, Single Duration	ADXL375	Q19936.1.RD1_RES	0/20
				Q19936.2.RD2_RES	0/20
				Q19936.3.RD3_RES	0/20
Temperature Cycling (TC)[1]	JESD22-A104	-65°C/+150°C, 500 Cycles	ADXL375	Q19936.1.TC1_RES	0/77
				Q19936.1.TC2_RES	0/77
				Q19936.3.TC3_RES	0/77
Unbiased HAST (UHST)[1]	JESD22-A118	110°C 85%RH 17.7 psia, 264hrs	ADXL375	Q19936.1.UH1_RES	0/77
				Q19936.3.UH2_RES	0/77
				Q19936.3.UH3_RES	0/77

[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 peak temperature of 260°C.

Table 3: Die/Fab Test Results for ADXL375 - 0.35um CMOS at TSMC Fab-11

Test Name	Spec	Conditions	Generic/Root Part #	Lot #	Fail/SS
Early Life Failure Rate (ELFR)	MIL-STD-883, Method 1015	150°C, 48 Hours	ADXL345	Q8378	0/1760
	MIL-STD-883, Method 1015	Ta=125°C, 48 Hours	ADXL345	Q10554	0/2010
High Temperature Operating Life (HTOL)[1]	JESD2-A108	150°C<Tj<175°C Biased, 500 Hours	ADXL345	Q9681.1	0/77
				Q9681.2	0/77
				Q9681.3	0/77
High Temperature Storage Life (HTSL)	JESD22-A103	150°C, 1,000 Hours	ADXL375	Q13713.HS1	0/77
				Q13713.HS2	0/77
				Q13713.HS3	0/77
Temperature Humidity Bias (THB)[1]	JESD22-A101	85C 85%RH, Biased, 1000 Hours	ADXL375	Q13713.UH1	0/77
				Q13713.UH2	0/77
				Q13713.UH3	0/77

[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 peak temperature of 260°C.

Table 4: Die/Fab Test Results for ADXL377 - 0.35um CMOS at Magnachip CF-4

Test Name	Spec	Conditions	Generic/Root Part #	Lot #	Fail/SS
Early Life Failure Rate (ELFR)	MIL-STD-883, Method 1015	Ta=125°C, 48 Hours	ADXL377	Q9687	0/1980
High Temperature Operating Life (HTOL)[1]	JESD2-A108	125°C < Tj < 135°C, Biased, 1,000 Hours	ADXL377	Q11259.9	0/77
				Q11259.10	0/77
				Q11259.11	0/77
High Temperature Storage Life (HTSL)	JESD22-A103	150°C, 1,000 Hours	ADXL377	Q11259.13	0/77
				Q11259.14	0/77
				Q11259.15	0/77
Highly Accelerated Temperature and Humidity Stress Test (HAST)[1]	JESD22-A101	130°C, 85%RH, 2atm, Biased, 96 Hours	ADXL377	Q11259.9	0/77
				Q11259.10	0/77
				Q11259.11	0/77

[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 peak temperature of 260°C.

Package/Assembly Product Characteristics

Table 5: Package/Assembly Product Characteristics – ADXL375/377

Product Characteristics	Product(s) to be qualified	
Generic/Root Part #	ADXL375	ADXL377
Package	14-LGA	16-LFCSP
Body Size (mm)	3.00 x 5.00 x 0.95	3.00 x 3.00 x 1.45
Assembly Location	AMKOR (AP3)	AMKOR (AP1)
MSL/Peak Reflow Temperature(°C)	3 / 260°C	3 / 260°C
Mold Compound	Sumitomo G770	Sumitomo G770HCD
Die Attach/Underfill	Ablestik 2300 conductive / NA	QMI 536
Leadframe Material	BT Resin	Cu7025
Lead Finish	AU	Ag
Wire Bond Material/Diameter (mils)	Tanaka GPG 2N Gold / 1.00	Tanaka GPG 2N Gold / 0.80

Package/Assembly Test Results

Table 6: Package/Assembly Test Results for ADXL375 – LGA at AMKOR (AP3)

Test Name	Spec	Conditions	Generic/Root Part #	Lot #	Fail/SS
Group D	MIL-STD-883, M5005	Sub 4, Shock/Vib/Cent.,	ADXL375	Q19936.1.GD1_RES	0/39
				Q19936.2.GD2_RES	0/39
				Q19936.3.GD3_RES	0/39
High Temperature Storage Life (HTSL)	JESD22-A103	150°C, 1,000 Hours	ADXL375	Q13713.HS1	0/77
				Q13713.HS2	0/77
				Q13713.HS3	0/77
Low Temperature Storage (LTS)	JESD22-A119	-55°C, 1,000 Hours	ADXL375	Q13713.LS1	0/77
				Q13713.LS2	0/77
				Q13713.LS3	0/77
Preconditioning	J-STD-020	MSL3	ADXL375	Q10491.UH1	0/77
				Q10491.UH2	0/77
				Q10491.UH3	0/77
Temperature Cycling (TC)[1]	JESD22-A104	-65°C/+150°C, 500 Cycles	ADXL375	Q19936.1.TC1_RES	0/77
				Q19936.1.TC2_RES	0/77
				Q19936.3.TC3_RES	0/77
Temperature Humidity Bias (THB)[1]	JESD22-A101	85C 85%RH, Biased, 1000 Hours	ADXL375	Q13713.UH1	0/77
				Q13713.UH2	0/77

				Q13713.UH3	0/77
Unbiased HAST (UHST)[1]	JESD22-A118	110°C 85%RH 17.7 psia, 264hrs	ADXL375	Q19936.1.UH1_RES	0/77
				Q19936.3.UH2_RES	0/77
				Q19936.3.UH3_RES	0/77

[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 peak temperature of 260°C.

Table 7: Package/Assembly Test Results for ADXL377 – LFCSP at AMKOR (AP3)

Test Name	Spec	Conditions	Generic/Root Part #	Lot #	Fail/SS
Group D	MIL-STD-883, M5005	Sub 4, Shock/Vib./Cent. Single Duration	ADXL377	Q9687.16	0/20
				Q9687.17	0/20
				Q9687.18	0/20
High Temperature Storage Life (HTSL)	JESD22-A103	150°C, 1,000 Hours	ADXL377	Q9687.13	0/77
				Q9687.14	0/77
				Q9687.15	0/77
Autoclave (AC)	JESD22-A102	121C, 100%RH, 2atm, 96 Hours	ADXL377	Q9687.4	0/77
				Q9687.5	0/77
				Q9687.6	0/77
High Temperature Storage Life (HTSL)	JESD22-A103	150°C, 1,000 Hours	ADXL377	Q11259.13	0/77
				Q11259.14	0/77
				Q11259.15	0/77
Solder Heat Resistance (SHR)[1]	ADI-0049	MSL-3	ADXL377	Q9687.25	0/10
				Q9687.26	0/10
				Q9687.27	0/10
Temperature Cycling (TC)[1]	JESD22-A104	-65°C/+150°C, 500 Cycles	ADXL377	Q9687.7	0/77
				Q9687.8	0/77
				Q9687.9	0/77
Highly Accelerated Temperature and Humidity Stress Test (HAST)[1]	JESD22-A110	130°C 85%RH, Biased, 96 Hours	ADXL377	Q9687.10	0/77
				Q9687.11	0/77
				Q9687.12	0/77

[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 peak temperature of 260°C.

ESD and Latch-Up Test Results for ADXL345

Table 8: ESD Test Result

ESD Model	Generic/Root Part #	Package	ESD Test Spec	RC Network	Highest Pass Level	Class
FICDM	ADXL345	14-LGA	ANSI/ESD STM5.3.1-1999	1Ω, Cpkg	±1500V	C6
HBM	ADXL345	14-LGA	ANSI/ESD STM5.1-2007	1.5kΩ, 100pF	±2000V	2

Table 9: Latch Up Test Result

LU Test Spec	Generic/Root Part #	Passing Current	Passing Over-Voltage	Temperature (T_A)	Class
JESD78	ADXL345	+100mA, -100mA	+5.4V	25°C	I

ESD and Latch-Up Test Results for ADXL377

Table 10: ESD Test Result

ESD Model	Generic/Root Part #	Package	ESD Test Spec	RC Network	Highest Pass Level	Class
FICDM	ADXL377	16-LFCSP	JESD22-C101	1Ω, Cpkg	±2000V	IV
HBM	ADXL377	16-LFCSP	ESDA/JEDEC JS-001-2011	1.5kΩ, 100pF	±3000V	2

Table 11: Latch Up Test Result

LU Test Spec	Generic/Root Part #	Passing Current	Passing Over-Voltage	Temperature (T_A)	Class
JESD78	ADXL377	+100mA, -100mA	+4.95V	25°C	I

Approvals

Reliability Engineer: Michael Walornyj