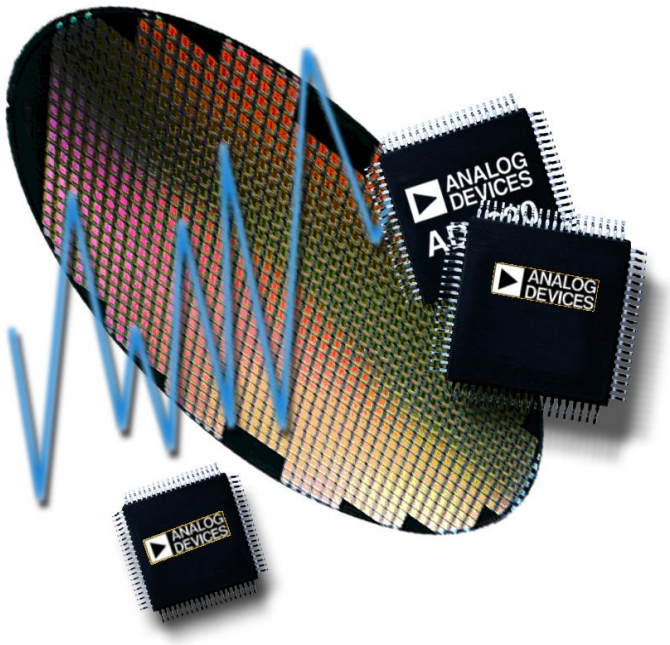


Reliability Report

Report Title: ADBMS6815M and ADBMS6817M Die Rev D Qualification

Report Number: 20961

Revision: A

Date: 2 January 2024

Summary

This report documents the successful completion of the reliability qualification requirements for the release of the ADBMS6815M and ADBMS6817M products with die revision D. This die change is required to reduce the product hot plug performance sensitivity to process variations seen on the products. The ADBMS6815M is fabricated in ADI CAMAS using the 7um Bipolar process and in Global Foundries using the 0.13um DMOS process. It is assembled in a 48-LFCSP_SS package at UT2. The ADBMS6815M is a multicell battery stack monitor that measures up to 12 series connected battery cells with a lifetime total measurement error of less than 1.2mV. The ADBMS6817M is the 8-cell version with a total measurement error of less than 1.5mV.

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, Table 2.1 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, Table 2.1 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 - 7um BIPOLAR

Product Characteristics	Product(s) to be qualified		Product(s) used for Substitution Data		
Generic/Root Part #	ADBMS6815M	ADBMS6817M	ADBMS6816	ADBMS6815	ADBMS6830
Die Id	6L815PV-F 08	6L815PV-F 08	6L815PV-F 08	L815	W815
Die Size (mm)	0.74 x 1.47	0.74 x 1.47	0.74 x 1.47	0.74 x 1.47	0.74 x 1.47
Wafer Fabrication Site	I_CAMA0106	I_CAMA0106	I_CAMA0106	I_CAMA0106	I_CAMA0106
Wafer Fabrication Process	BIPOLAR	BIPOLAR	BIPOLAR	BIPOLAR	BIPOLAR
Die Substrate	Si	Si	Si	Si	Si
Metallization / # Layers	AlCu(0.5%)/1	AlCu(0.5%)/1	AlSiCu/1	AlSiCu/1	AlSiCu/1
Polyimide	No	No	No	No	No
Passivation	doped-oxide/SiN	doped-oxide/SiN	undoped-oxide/SiN	Undoped-oxide/OxyNitride	undoped-oxide/SiN

Table 1.1: Die/Fab Product Characteristics - 0.13um DMOS

Product Characteristics	Product(s) to be qualified		Product(s) used for Substitution Data		
Generic/Root Part #	ADBMS6815M	ADBMS6817M	ADBMS2960	ADBMS6830	ADBMS6832
Die Id	SENTRY 01	SENTRY 01	ADBMS2960_ PANTHER 01	ADI_LION.01/B	ADI_LION18.04 D0003A_05
Die Size (mm)	2.87 x 3.12	2.87 x 3.12	3.42 x 2.47	4.32 x 3.10	4.32 x 3.23
Wafer Fabrication Site	E_GLBL0712	E_GLBL0712	E_GLBL0712	E_GLBL0712	E_GLBL0712
Wafer Fabrication Process	0.13um DMOS	0.13um DMOS	0.13um DMOS	0.13um DMOS	0.13um DMOS
Die Substrate	Si	Si	Si	Si	Si
Metallization / # Layers	AlSi(1.0%)Cu(0.5%)/5	AlSi(1.0%)Cu(0.5%)/5	AlCu(0.5%)/5	AlCu/5	AlCu(0.5%)/5
Polyimide	No	No	No	No	No
Passivation	doped-oxide/OxyNitride	doped-oxide/OxyNitride	doped-oxide/OxyNitride	doped-oxide/OxyNitride	doped-oxide/OxyNitride

Die/Fab Test Results

Table 2: Die/Fab Test Results – 7um BIPOLAR at ADI-Camas

Test Name	AEC #	Spec	Conditions	Generic/Root Part #	Lot #	Fail/SS	eTest Temp
Early Life Failure Rate (ELFR)	B2	AEC-Q100-008	Ta=125°C, 48 Hours	ADBMS6816	Q17013.EL1APION_NP-Au	0/300	RH
					Q17013.EL1BPION_NP-Au	0/300	RH
					Q17013.EL1CPION_NP-Au	0/200	RH
					Q17013.EL2APION_NP-Au	0/300	RH
					Q17013.EL2BPION_NP-Au	0/300	RH
					Q17013.EL2CPION_NP-Au	0/200	RH
					Q17013.EL3APION_NP-Au	0/300	RH
					Q17013.EL3BPION_NP-Au	0/300	RH
					Q17013.EL3CPION_NP-Au	0/200	RH
				ADBMS6830	Q17238.EL1A_LION80LQ	0/300	RH
					Q17238.EL1B_LION80LQ	0/300	RH
					Q17238.EL1C_LION80LQ	0/200	RH
					Q17238.EL2A_LION80LQ	0/300	RH
					Q17238.EL2B_LION80LQ	0/300	RH
					Q17238.EL2C_LION80LQ	0/200	RH
					Q17238.EL3A_LION80L	0/300	RH
					Q17238.EL3B_LION80L	0/300	RH
					Q17238.EL3C_LION80L	0/200	RH
High Temperature Operating Life (HTOL)	B1	JESD22-A108	Ta=125°C, 1,000 Hours	ADBMS2950	Q19877.1.HOTIPUrevE	0/77	RCH
				ADBMS6830	Q19131.1.HO_L16D	0/77	RCH
				ADBMS6830M	Q18108.3.HO3L16CU	0/77	RCH
				ADBMS6830M	Q18108.3.HO3L16CU	0/77	RCH
				ADBMS6832	Q18939.1.HOLION18	0/77	RCH
					Q18939.2.HOLION18	0/77	RCH
					Q18939.3.HOLION18	0/77	RCH
					Q19822.1.HO	0/77	RCH
			Ta=125°C, Biased, 2,000 Hours	ADBMS6830	Q17238.HO1_LION80L	0/77	RCH
					Q17238.HO2_LION80L	0/77	RCH
					Q17238.HO3_LION80L	0/77	RCH

High Temperature Storage Life (HTSL)	A6	JESD22-A103	150°C, 1,000 Hours	ADBMS6830	Q17238.HS_LION80L	0/49	RH
				LTC6811-1	Q20009.2.HSRedo	0/77	RH
			150°C, 2,000 Hours	ADBMS6830M	Q18108.1.HS1-L16CU	0/49	RH
					Q18108.2.HS2-L16CU	0/49	RH
					Q18108.3.HS3-L16CU	0/49	RH
Highly Accelerated Temperature and Humidity Stress Test (HAST)[1]	A2	JESD22-A110	130C 85%RH 33.3 psia, Biased, 96 Hours	ADBMS1804	Q20001.1.HA1	0/77	RH
				ADBMS6815	Q18424.1.HA1	0/77	RH
					Q18424.2.HA2	0/77	RH
					Q18424.3.HA3	0/77	RH
				ADBMS6816	Q17013.HA1PIONEER_NP-Au	0/77	RH
					Q17013.HA2PIONEER_NP-Au	0/77	RH
					Q17013.HA3PIONEER_NP-Au	0/77	RH
				ADBMS6830	Q17238.HA1_LION80L	0/77	RH
					Q17238.HA2_LION80L	0/77	RH
					Q17238.HA3_LION80L	0/77	RH
Temperature Humidity Bias (THB)[2]	A2	JESD22-A101	85°C, 85%RH, Biased, 2,000 Hours	ADBMS6815M	Q17951.1.TH1B-SenCu	0/77	RH
					Q17951.3.TH3SenCu	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.

Table 2.1: Die/Fab Test Results - 0.13um DMOS at GlobalFoundries Fab-7

Test Name	AEC #	Spec	Conditions	Generic/Root Part #	Lot #	Fail/SS	eTest Temp
Early Life Failure Rate (ELFR)	B2	AEC-Q100-008	Ta=125°C, 48 Hours	ADBMS6816	Q17013.EL1APION_NP-Au	0/300	RH
					Q17013.EL1BPION_NP-Au	0/300	RH
					Q17013.EL1CPION_NP-Au	0/200	RH
					Q17013.EL2APION_NP-Au	0/300	RH
					Q17013.EL2BPION_NP-Au	0/300	RH
					Q17013.EL2CPION_NP-Au	0/200	RH
					Q17013.EL3APION_NP-Au	0/300	RH
					Q17013.EL3BPION_NP-Au	0/300	RH
					Q17013.EL3CPION_NP-Au	0/200	RH
				ADBMS6830	Q17238.EL1A_LION80LQ	0/300	RH
					Q17238.EL1B_LION80LQ	0/300	RH
					Q17238.EL1C_LION80LQ	0/200	RH
					Q17238.EL2A_LION80LQ	0/300	RH
					Q17238.EL2B_LION80LQ	0/300	RH
					Q17238.EL2C_LION80LQ	0/200	RH
					Q17238.EL3A_LION80L	0/300	RH
					Q17238.EL3B_LION80L	0/300	RH
					Q17238.EL3C_LION80L	0/200	RH
High Temperature Operating Life (HTOL)	B1	JESD22-A108	Ta=125°C, 1,000 Hours	ADBMS2950	Q19877.1.HOTIPUrevE	0/77	RCH
				ADBMS6815	Q20350.1.HOBMS6815REVG	0/77	RCH
				ADBMS6830	Q19131.1.HO_L16D	0/77	RCH
				ADBMS6830M	Q18108.3.HO3L16CU	0/77	RCH
				ADBMS6832	Q18939.1.HOLION18	0/77	RCH
					Q18939.2.HOLION18	0/77	RCH
					Q18939.3.HOLION18	0/77	RCH
					Q19822.1.HO	0/77	RCH
			Ta=125°C, Biased, 2,000 Hours	ADBMS6830	Q17238.HO1_LION80L	0/77	RCH
					Q17238.HO2_LION80L	0/77	RCH
					Q17238.HO3_LION80L	0/77	RCH

High Temperature Storage Life (HTSL)	A6	JESD22-A103	150°C, 1,000 Hours	ADBMS6830	Q17238.HS_LION80L	0/49	RH
			150°C, 2,000 Hours	ADBMS6830M	Q18108.2.HS2-L16CU	0/49	RH
					Q18108.3.HS3-L16CU	0/49	RH
Highly Accelerated Temperature and Humidity Stress Test (HAST)[1]	A2	JESD22-A110	110C 85%RH 17.7 psia, Biased, P264	ADBMS2960	Q20478.1.HAPANTHER	0/77	RH
			130C 85%RH 33.3 psia, Biased, 96 Hours	ADBMS6815	Q18424.1.HA1	0/77	RH
					Q18424.2.HA2	0/77	RH
					Q18424.3.HA3	0/77	RH
				ADBMS6815M	Q17978.1.HASenG	0/77	RH
				ADBMS6816	Q17013.HA1PIONEER_NP-Au	0/77	RH
					Q17013.HA2PIONEER_NP-Au	0/77	RH
					Q17013.HA3PIONEER_NP-Au	0/77	RH
				ADBMS6830	Q17238.HA1_LION80L	0/77	RH
					Q17238.HA2_LION80L	0/77	RH
					Q17238.HA3_LION80L	0/77	RH
Temperature Humidity Bias (THB)[1]	A2	JESD22-A101	85°C, 85%RH, Biased, 2,000 Hours	ADBMS6815M	Q17951.1.TH1B-SenCu	0/77	RH
					Q17951.3.TH3SenCu	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 - 48-LFCSP_SS at UTAC (UT2)

Product Characteristics	Product(s) to be qualified	Product(s) used for Substitution Data		
Generic/Root Part #	ADBMS6815M	ADBMS2950	ADBMS2960	ADBMS6815M
Package	48-LFCSP_SS	48-LFCSP_SS	48-LFCSP_SS	48-LFCSP_SS
Body Size (mm)	7.00 x 7.00 x 0.75	7.00 x 7.00 x 0.75	7.00 x 7.00 x 0.75	7.00 x 7.00 x 0.75
Assembly Location	UTAC (UT2)	UTAC (UT2)	UTAC (UT2)	UTAC (UT2)
MSL/Peak Reflow Temperature(°C)	3 / 260°C	3 / 260°C	3 / 260°C	3 / 260°C
Mold Compound	Sumitomo G700LTD	Sumitomo G700LTD	Sumitomo G700LTD	Sumitomo G700LTD
Die Attach	Ablestik 8600 conductive	Ablestik 8600 conductive	Ablestik 8600 conductive	Ablestik 8600 conductive
Leadframe Material	Copper	Copper	Copper	Copper
Lead Finish	100Sn	100Sn	100Sn	100Sn
Wire Bond Material/Diameter (mils)	PdCuAu 4N / 1.00	PdCuAu 4N / 1.00	PdCuAu 4N / 1.00	PdCuAu 4N / 1.00

Package/Assembly Test Results

Table 4: Package/Assembly Test Results - LFCSP_SS at UTAC (UT2)

Test Name	AEC #	Spec	Conditions	Generic/Root Part #	Lot #	Fail/SS	eTest Temp
High Temperature Storage Life (HTSL)	A6	JESD22-A103	150°C, 2,000 Hours	ADBMS6830M	Q18108.1.HS1-L16CU	0/49	RH
					Q18108.2.HS2-L16CU	0/49	RH
					Q18108.3.HS3-L16CU	0/49	RH
Highly Accelerated Temperature and Humidity Stress Test (HAST)[1]	A2	JESD22-A110	110C 85%RH 17.7 psia, Biased, P264	ADBMS2960	Q20478.1.HAPANTHER	0/77	RH
Temperature Cycling (TC)[1]	A4	JESD22-A104	-65°C/+150°C, 500 Cycles	ADBMS6830	Q19836.1.TC-Li16revE	0/77	H
			-55C/+150C, 2,000 Cycles	ADBMS6815M	Q17951.1.TC1SenCu	0/77	H
					Q17951.2.TC2SenCu	0/71[2]	H
					Q17951.3.TC3SenCu	0/71[2]	H
				ADBMS6830M	Q18108.1.TC1_L16CU	0/77	H
					Q18108.2.TC2_L16CU	0/77	H
					Q18108.3.TC3_L16CU	0/77	H
Temperature Humidity Bias (THB)[1]	A2	JESD22-A101	85°C, 85%RH, Biased, 2,000 Hours	ADBMS6815M	Q17951.1.TH1B-SenCu	0/77	RH
					Q17951.3.TH3SenCu	0/77	RH
Unbiased HAST (UHST)[1]	A3	JESD22-A118	130C 85%RH 33.3 psia, 96 Hours	ADBMS2950	Q18620.1.UH1_TiCuRC	0/77	R
					Q18620.2.UH2_TiCuRC	0/77	R
					Q18620.3.UH3_TiCuRC	0/77	R
				ADBMS6832	Q19822.1.UH-LION18	0/77	R
				ADBMS6832	Q18939.1.UHLION18	0/77	R
					Q18939.2.UHLION18	0/77	R

[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.

[2] Sample size reduced due to missing/damaged unit

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
HBM	ADBMS6815M	48-LFCSP_SS	AEC-Q100-002	1.5kΩ, 100pF	±2000V	2	RH
FICDM	ADBMS6815M	48-LFCSP_SS	AEC Q100-011	1Ω, Cpkg	±1000V	C3	RH

Table 6: Latch Up Test Result

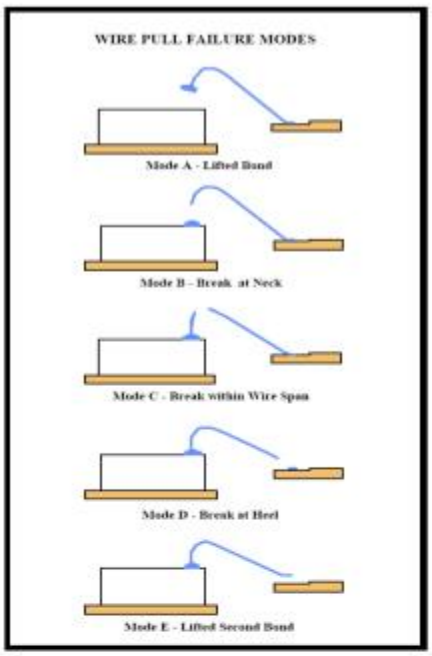
LU Test Spec	Generic/Root Part #	Passing Current	Passing Over-Voltage	Temperature (T_A)	Class	eTest Temp
JESD78	ADBMS6815M	+200mA, -200mA	+6.3, 75.3V	125°C	II	RH

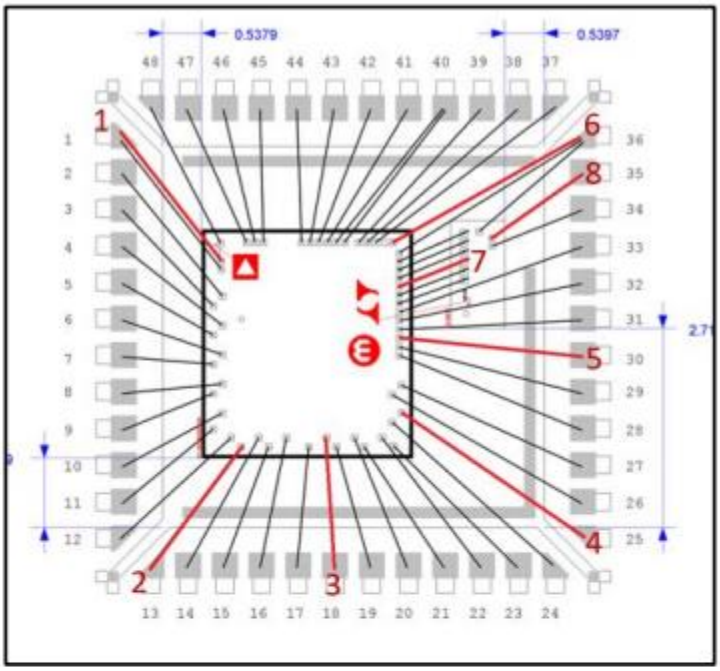
Approvals

Reliability Engineer: Ryan Quintin

Appendix

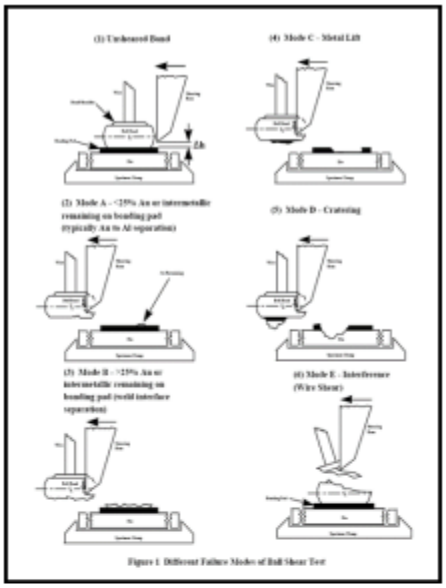
A. Post-TCT Wirebond pull test

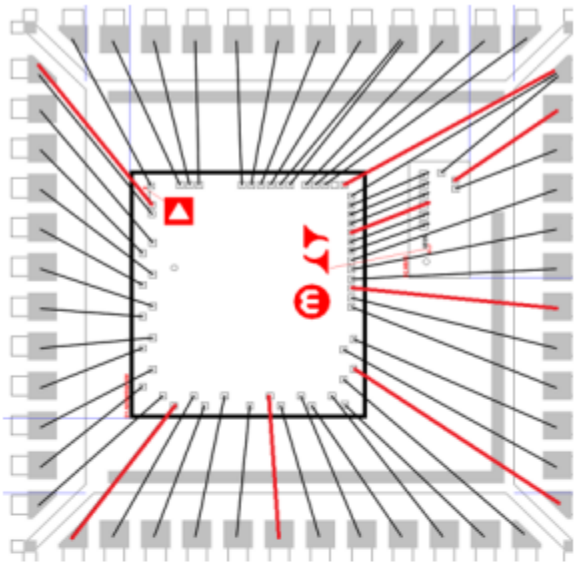




PCL-3354_Q17978.1.HASENG										
Unit	1		2		3		4		5	
Ball	Pull	Mode	Pull	Mode	Pull	Mode	Pull	Mode	Pull	Mode
1	5.83	B	6.84	B	6.44	B	6.17	B	6.66	B
2	5.83	B	6.53	B	7.72	B	6.73	B	7.43	B
3	6.14	B	7.41	B	6.79	B	5.94	B	7.00	B
4	5.95	B	6.20	B	5.69	B	5.95	B	6.25	B
5	5.92	B	6.20	B	6.81	B	6.74	B	6.99	B
6	5.73	B	6.56	B	5.92	B	7.21	B	7.29	B
7	7.61	B	8.04	B	8.07	B	7.52	B	7.91	B
8	7.56	B	8.30	B	8.12	B	7.68	B	8.42	B
MIN	5.73		6.20		5.69		5.94		6.25	
MAX	7.61		8.30		8.12		7.68		8.42	
AVE	6.32		7.01		6.95		6.74		7.24	
STDEV	0.79		0.82		0.94		0.69		0.69	

B. Post-TCT Wirebond shear test





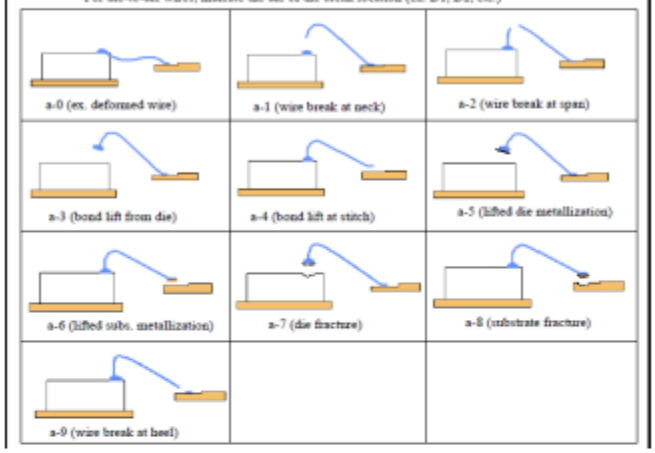
PCL-3358										
Unit	1		2		3		4		5	
Ball	Shear	Mode	Shear	Mode	Shear	Mode	Shear	Mode	Shear	Mode
1	56.05	B	55.81	B	51.09	B	55.39	B	45.95	B
2	37.29	B	47.24	B	55.39	B	50.61	B	48.52	B
3	41.40	B	49.53	B	55.69	B	51.38	B	52.21	B
4	38.07	B	47.93	B	51.38	B	48.41	B	49.39	B
5	48.21	B	50.57	B	48.41	B	49.65	B	50.68	B
6	58.51	B	50.33	B	49.46	B	45.99	B	50.64	B
7	48.77	B	43.73	B	45.99	B	43.15	B	46.33	B
8	48.84	B	50.21	B	44.15	B	46.14	B	48.34	B
MIN	37.29		43.73		44.15		43.15		45.95	
MAX	58.51		55.81		55.69		55.39		52.21	
AVE	47.14		49.42		50.20		48.84		49.01	
STDEV	7.82		3.44		4.09		3.80		2.17	

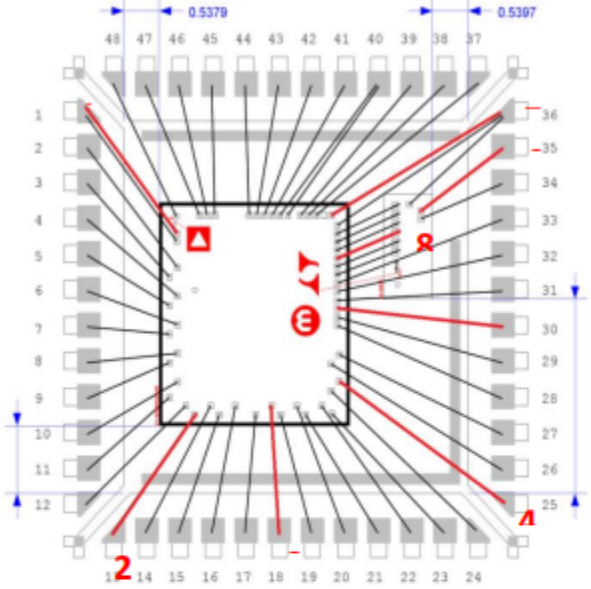
C. Post-HAST Wirebond pull test

Wire Pull Test Failure Modes

Mode	Description
a-0	Wire damaged/broken/missing prior test, or unsuitable for test
a-1	Wire break at neckdown point (reduction of cross section due to bonding process)
a-2	Wire break at point other than neckdown
a-3	Failure in bond (interface between wire and metallization) at die*
a-4	Failure in bond (interface between wire and metallization) at substrate, package post, or other than die
a-5	Lifted metallization from die*
a-6	Lifted metallization from substrate or package post
a-7	Fracture of die*
a-8	Fracture of substrate
a-9	Wire break at neckdown point on the substrate or package post

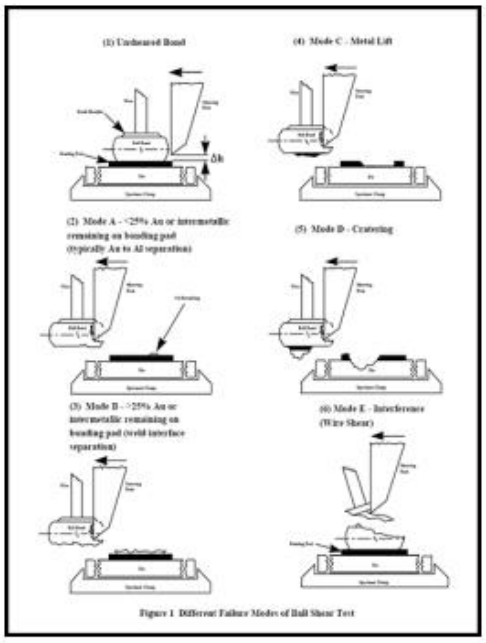
*For die-to-die wires, indicate the die of the break location (ex. D1, D2, etc.)

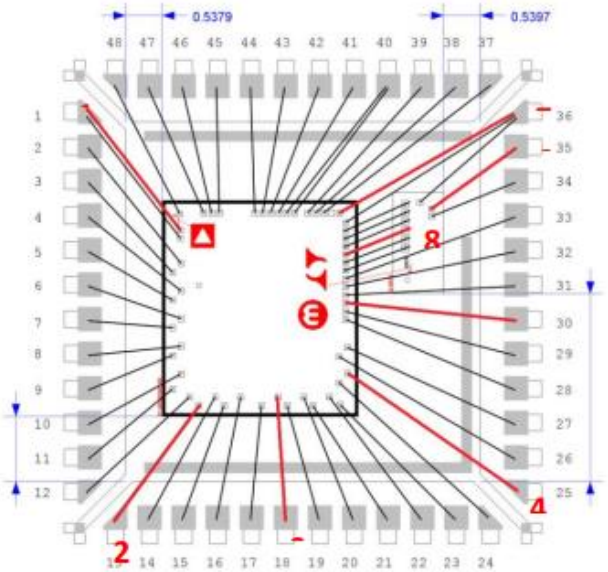




PCL-3416_Q17978.1.HASENG										
Unit	1		2		3		4		5	
Ball	Pull	Mode	Pull	Mode	Pull	Mode	Pull	Mode	Pull	Mode
1	6.07	a-1	6.54	a-1	7.09	a-1	7.35	a-1	8.06	a-1
2	6.96	a-1	7.07	a-1	7.04	a-1	7.18	a-1	9.31	a-1
3	7.36	a-1	7.67	a-1	7.14	a-1	6.54	a-1	8.00	a-1
4	5.48	a-1	5.64	a-1	5.62	a-1	5.72	a-1	5.93	a-1
5	5.53	a-1	5.72	a-1	5.63	a-1	6.59	a-1	5.83	a-1
6	6.66	a-1	7.24	a-1	7.26	a-1	6.78	a-1	8.06	a-1
7	5.16	a-1	5.67	a-1	5.20	a-1	5.57	a-1	6.01	a-1
8	8.17	a-1	8.73	a-1	8.31	a-1	9.03	a-1	8.77	a-1
MIN	5.16		5.64		5.20		5.57		5.83	
MAX	8.17		8.73		8.31		9.03		9.31	
AVE	6.42		6.79		6.66		6.85		7.50	
STDEV	1.05		1.11		1.06		1.08		1.38	

D. Post-HAST Wirebond shear test





PCL-3417_Q17978.1.HASENG										
Unit	Unit 1		Unit 2		Unit 3		Unit 4		Unit 5	
Ball	Shear	Mode	Shear	Mode	Shear	Mode	Shear	Mode	Shear	Mode
1	44.16	B	39.78	B	59.51	B	49.10	B	49.89	B
2	65.90	B	34.96	B	39.61	B	44.88	B	44.54	B
3	60.15	B	37.83	B	36.89	B	48.00	B	42.21	B
4	53.19	B	63.65	B	38.75	B	46.21	B	46.84	B
5	55.43	B	60.66	B	41.23	B	42.13	B	44.74	B
6	53.75	B	49.91	B	42.61	B	48.35	B	40.42	B
7	58.39	B	55.60	B	40.37	B	43.58	B	49.64	B
8	52.49	B	60.06	B	39.13	B	46.35	B	44.90	B
MIN	44.16		34.96		36.89		42.13		40.42	
MAX	65.90		63.65		59.51		49.10		49.89	
AVE	55.43		50.31		42.26		46.08		45.40	
STDEV	6.37		11.41		7.17		2.43		3.31	