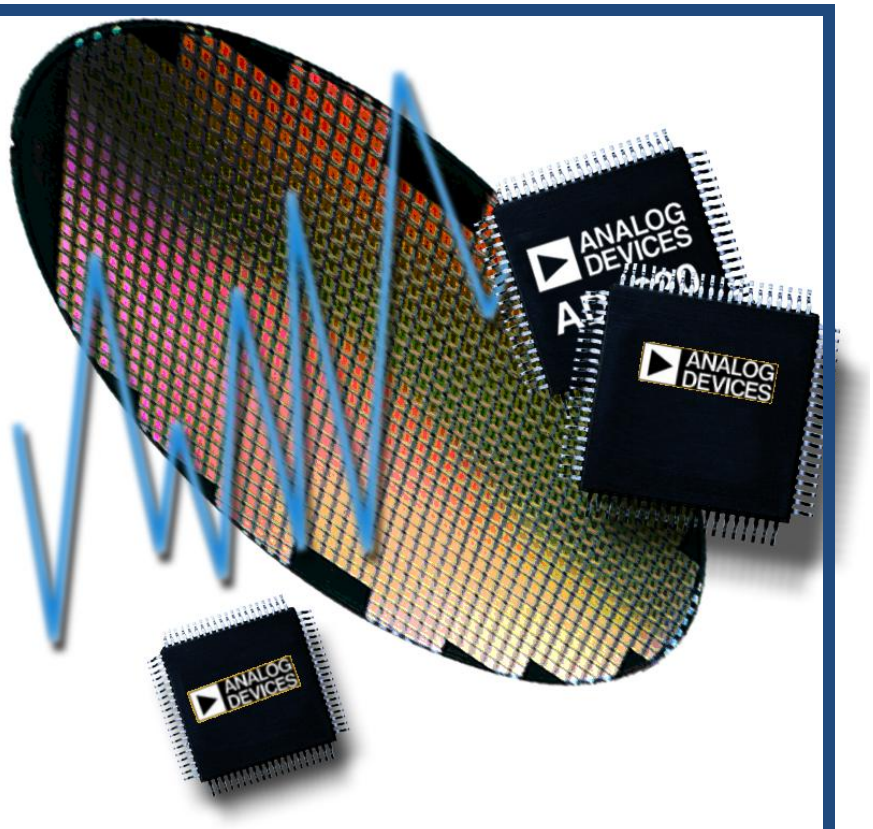

Reliability Report

Report Title: ADSP-BF538F8 /ADSP-BF539F8 Alternate Fab Site Qualification

Report Number: 9127

Revision: A

Date: 15 April 2011

Summary

This report documents the successful completion of the reliability qualification requirements for release of the ADSP-BF538F8 and ADSP-BF539F8 products with the Spansion S29AL008J Flash die fabricated at Spansion's Fab-25 fab in Austin, Texas. These devices are two-chip MCM's consisting of an ADSP-BF538/9 Blackfin DSP and adjacent 8Mb Spansion S29AL008J Flash memory chip. They have been previously qualified using the same Spansion S29AL008J die fabricated on the same 0.11µm CMOS Flash wafer fab process at Spansion's JV3 fab in Aizu-Wakamatsu, Japan. No changes were made to the ADSP-BF538/9 DSP die. The ADSP-BF539F8 was chosen as the qualification vehicle; other than the inclusion of an additional (MXVR) peripheral on the ADSP-BF539F8, the two products are identical.

Table 1: ADSP-BF539F8 Product Characteristics

Die/Fab

Die ID	E0171A	S29AL008J
Die Size (mm)	6.04 x 5.90	1.96 x 4.30
Wafer Fabrication Site	TSMC Fab-12	Spansion Fab-25
Wafer Fabrication Process	0.13µm CMOS	0.11µm CMOS FLASH
Approximate Transistor Count	10.0 million	-
Passivation Layer	undoped-oxide/SiN	undoped-oxide/SiN
Bond Pad Metal Composition	AlCu	AlCu

Package/Assembly

Package	316-CSP_BGA
Body Size (mm)	17.00 x 17.00 x 1.25
Solder Ball Pitch (mm)	0.80
Solder Ball Diameter (mm)	0.45
Operating Temperature Range	-40°C < T_A < 105°C
Assembly Location	STATS
Molding Compound	Sumitomo G770
Wire Type	Gold Tanaka GPG
Wire Diameter (mils)	1.00
Die Attach	Ablestik 2000
Substrate Laminate Supplier	Samsung
Substrate Material	BT resin / DS7409HGB
Solder Ball Composition	S.B. 96.5Sn/3Ag/0.5Cu
Moisture Sensitivity Level	3
Maximum Peak Reflow Temperature (°C)	260

Description / Results of Tests Performed

Tables 2 through 4 provide a description of the qualification tests conducted and the associated test results for products manufactured on the same technologies as described in Table 1. All devices were electrically tested before and after each stress. Any device that did not meet all electrical data sheet limits following stressing would be considered a valid (stress-attributable) failure unless there was conclusive evidence to indicate otherwise.

Table 2: CSP_BGA at STATS Package Qualification Test Results

Test Name	Specification	Conditions	Device	Lot #	Sample Size	Qty. Failures
High Temperature Storage Life (HTSL)[1]	JESD22-A103	150°C, 1,000 Hours	ADSP-BF539F8	1796374.1	45	0
Low Temperature Storage (LTS)[1]	JESD22-A119	-65C, 1,000 Hours		1806493.1	45	0
Solder Ball Shear (SBS)[4]	AEC-Q100-010	Post – 2x 220°C reflow, 5 balls/device		1796374.1	10	Cpk=1.38
				1806493.1	10	
				1815605.1	10	
Solder Heat Resistance (SHR)[2,3]	ADI-0049	MSL-3		1796374.1	11	0
				1806493.1	11	0
				1815605.1	11	0
Temperature Cycling (TC)[1,3,5]	JESD22-A104	-55°C/+125°C, 1,000 Cycles		1796374.1	77	0
				1806493.1	77	0
				1815605.1	77	0
Temperature Humidity Bias (THB)[1,3]	JESD22-A101	85°C, 85%RH, Biased, 1,000 Hours		1796374.1	77	0
				1806493.1	77	0
				1815605.1	77	0
Unbiased HAST (UHST)[2,3]	JESD22-A118	130°C, 85%RH, 2atm, 96 Hours		1796374.1	77	0
				1806493.1	77	0
				1815605.1	77	0

[1] Pre- and post-stress electrical test was performed at room and hot temperatures.

[2] Pre- and post-stress electrical test performed at room temperature.

[3] 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, Unbiased Soak: 192 hrs @ 30°C, 60%RH, Reflow: 3 passes through an oven with a peak temperature of 260°C.

[4] Complete solder-ball shear results are presented in Appendix A of this report.

[5] Post-TCT wire bond pull testing was performed per AEC-Q100 on five devices from TCT lot #1796374.1. Minimum bond pull recorded was 5.10 grams on the ADSP-BF539 die, and 5.00 grams for the S29AL008J die. Complete data for the five units are presented in Appendix B of this report.

Table 3: 0.13µm CMOS at TSMC Fab-12 Fab Qualification Test Results

Test Name	Specification	Conditions	Device	Lot #	Sample Size	Qty. Failures
Early Life Failure Rate (ELFR)[1]	AEC-Q100-008	Biased, Dynamic T_A≥105°C, 48 hours	ADSP-BF533W	1512987.1	1000	0
				1512990.1	1000	0
				1517536.1	1000	0
			ADSP-21365W	QL6890ELF01	1000	0
				QL6890ELF02	1000	0
				QL6890ELF03	1000	0
High Temperature Operating Life (HTOL)[2]	JESD22-A108	Biased, Dynamic, T_A=115°C, 125°C ≤ T_J ≤ 150°C 1,000 hours	ADSP-BF533	ERN14185B	45	0
				ERN16081V	45	0
				ERN17478S	45	0
		Biased, Dynamic, T_A=105°C, 125°C ≤ T_J ≤ 150°C 1,000 hours	ADSP-BF539	ERN60954A	45	0
				ERN60953B	45	0
				525038.1	45	0
				764661.1	45	0
				746884.1	45	0
		Biased, Dynamic, T_A=105°C, 125°C ≤ T_J ≤ 150°C 1,000 hours	ADSP-BF539F8	1729943.1	77	0
				1976776.1	77	0

[1] Pre- and post-stress electrical test was performed at room and hot temperatures.
[2] Pre- and post-stress electrical test was performed at hot, room and cold temperatures.

Table 4: 0.11µm CMOS FLASH at Spansion Fab-25 Fab Qualification Test Results

Test Name	Specification	Conditions	Device	Lot #	Sample Size	Qty. Failures
Early Life Failure Rate (ELFR)[1]	AEC-Q100-008	Biased, T_A=150°C 24 hours	Various	17 lots	6808	0
High Temperature Operating Life (HTOL)[2]	JESD22-A108	Biased, Dynamic, T_A=105°C, 125°C ≤ T_J ≤ 150°C 1,000 hours	ADSP-BF539F8	1976776.1	77	0
		Biased, T_A=150°C 408 hours	S29AL016J	3 lots	900	0
NVM Endurance and Data Retention Test (EDR)[1]	AEC-Q100-005	Program/Erase: 100k cycles @ Vdd=3.6V, T_A=125°C	Various	4 lots	251	0

[1] Pre- and post-stress electrical test was performed at room and hot temperatures.
[2] Pre- and post-stress electrical test was performed at hot, room and cold temperatures.

Samples of the many devices manufactured with these package and process technologies are continuously undergoing reliability evaluation as part of the ADI Reliability Monitor Program. Additional qualification data is available on Analog Devices' web site.

ESD Test Results

The results of Human Body Model (HBM), Machine Model (MM), 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: ADSP-BF539F8 ESD Test Results

ESD Model	Package	ESD Test Spec	RC Network	Highest Pass Level	First Fail Level	Class
FICDM	316-CSP_BGA	JESD22-C101	1Ω, Cpkg	±1000V	±1500V	IV
HBM	316-CSP_BGA	ANSI/ESDA/JEDEC JS-001-2010	1.5kΩ, 100pF	±2500V	±3000V	2
MM	316-CSP_BGA	JESD22-A115	0Ω, 200pF	±150V	±200V	-

Latch-Up Test Results

Six samples of the ADSP-BF539F8 were latch-up tested at T_A=125°C per JEDEC Standard JESD78, Class II, Level A. Pre- and post-stress electrical test was performed at room and hot temperatures. All samples passed.

Approvals

Reliability Engineer: Dean Athanis

Additional Information

Data sheets and other additional information are available on Analog Devices' web site.

Appendices:

Appendix A: Solder Ball Shear Test Results
Appendix B: Post-TCT Wire Bond Pull Test Results

Appendix A

Solder Ball Shear Test Results

ADSP-BF539F8 halogen-free 316-CSP_BGA solder ball shear results

Solder Ball (SB) Diameter: 0.45mm Barrier Metal Diameter (SMD): 0.40mm
Per AEC-Q100-010: Min. Ball Shear Requirement: 0.405kgf Acceptable separation modes: 1, 4

Lot #1796374.1

DUT#	1		2		3		4		5		6		7		8		9		10	
SB #	kgf	mode	kgf	mode	kgf	mode	kgf	mode	kgf	mode	kgf	mode	kgf	mode	kgf	mode	kgf	mode	kgf	mode
1	0.680	1	0.662	1	0.774	1	0.724	1	0.670	1	0.708	1	0.760	1	0.964	1	0.694	1	0.626	1
2	0.738	1	0.744	1	0.724	1	0.678	1	0.744	1	0.702	1	0.922	1	0.742	1	0.708	1	0.648	1
3	0.686	1	0.730	1	0.668	1	0.622	1	0.896	1	0.766	1	0.754	1	0.806	1	0.676	1	0.584	1
4	0.616	1	0.714	1	0.720	1	0.672	1	0.764	1	0.730	1	0.710	1	0.704	1	0.712	1	0.854	1
5	0.766	1	0.868	1	0.682	1	0.784	1	0.878	1	0.694	1	0.684	1	0.744	1	0.634	1	0.722	1

Lot #1806493.1

DUT#	11		12		13		14		15		16		17		18		19		20	
SB #	kgf	mode	kgf	mode	kgf	mode	kgf	mode	kgf	mode	kgf	mode	kgf	mode	kgf	mode	kgf	mode	kgf	mode
1	0.632	1	0.752	1	0.764	1	0.672	1	0.638	1	0.764	1	0.674	1	0.680	1	0.682	1	0.682	1
2	0.728	1	0.654	1	0.630	1	0.610	1	0.626	1	0.686	1	0.680	1	0.756	1	0.744	1	0.744	1
3	0.748	1	0.730	1	0.744	1	0.622	1	0.708	1	0.688	1	0.778	1	0.780	1	0.788	1	0.650	1
4	0.546	1	0.670	1	0.484	1	0.686	1	0.662	1	0.678	1	0.660	1	0.722	1	0.710	1	0.758	1
5	0.740	1	0.902	1	0.746	1	0.720	1	0.728	1	0.668	1	0.754	1	0.692	1	0.618	1	0.714	1

Lot #1815605.1

DUT#	21		22		23		24		25		26		27		28		29		30	
SB #	kgf	mode	kgf	mode	kgf	mode	kgf	mode	kgf	mode	kgf	mode	kgf	mode	kgf	mode	kgf	mode	kgf	mode
1	0.604	1	0.622	1	0.688	1	0.772	1	0.688	1	0.630	1	0.714	1	0.792	1	0.692	1	0.672	1
2	0.712	1	0.678	1	0.882	1	0.602	1	0.664	1	0.678	1	0.898	1	0.724	1	0.790	1	0.686	1
3	0.682	1	0.666	1	0.690	1	0.714	1	0.664	1	0.714	1	0.684	1	0.658	1	0.678	1	0.788	1
4	0.650	1	0.708	1	0.668	1	0.794	1	0.700	1	0.730	1	0.886	1	0.722	1	0.774	1	0.682	1
5	0.774	1	0.686	1	0.720	1	0.732	1	0.764	1	0.612	1	0.516	1	0.652	1	0.604	1	0.660	1

Average	0.710	kgf
Minimum	0.484	kgf
Maximum	0.964	kgf
Sigma	0.074	kgf
Cpk	1.38	

Appendix B

Post-TCT Wire Bond Pull Test Results

Lot#: 1796374.1

Die #1: ADSP-BF539

Post-TCT Wire Bond Pull Strength (grams)					
DUT Bond	**1**	**2**	**3**	**4**	**5**
1	7.95	9.10	8.35	9.55	8.50
2	7.35	12.10	9.05	8.55	7.35
3	8.15	7.85	6.30	8.15	7.65
4	9.60	8.10	5.35	8.15	6.90
5	9.20	8.50	8.90	8.55	7.70
6	9.95	8.05	8.95	8.40	8.65
7	8.55	7.60	6.95	8.60	7.75
8	6.35	6.85	7.65	7.85	6.65
9	6.55	7.35	7.10	8.65	5.80
10	6.15	5.95	5.10	5.40	7.70
11	5.55	8.20	9.35	8.35	6.20
12	6.65	5.30	6.70	8.25	5.80

Min: 5.10 grams
Avg: 7.70 grams
Max: 12.10 grams
Std. Dev.: 1.34 grams

Die #2: S29AL008J (see note)

Post-TCT Wire Bond Pull Strength (grams)					
DUT Bond	**1**	**2**	**3**	**4**	**5**
1	8.75	7.70	8.95	8.30	8.90
2	8.50	7.75	9.85	9.80	9.30
3	8.15	9.35	7.75	7.00	9.55
4	8.50	7.45	6.55	7.45	8.35
5	8.35	7.55	7.80	7.25	8.60
6	7.70	7.35	5.00	7.20	7.00

Min: 5.00 grams
Avg: 8.06 grams
Max: 9.85 grams
Std. Dev.: 1.05 grams

NOTE: The S29AL008J die only has bond pads on two sides - corner bonds and one mid-bond pulled on each side.