Reliability Qualification Report

for

4Gb 1.8V Parallel NAND FLASH
with Pb/Halogen Free
(Automotive)

Issued Date: April 07, 2023

Contents :

1. Title

This report describes the reliability and qualification data of Alliance product listed below.

The qualification and reliability tests have been completed successfully based on AEC-Q100.

2. Product and Package Information

Product code	: AS9F14G08SA-45BAN
Operating temperature	: AEC-Q100 Grade 2 (-40°C to +105°C)
Package type	: FBGA 63B (9 x 11mm, 1.0T)
Solder ball	: SAC1205N (98.25% Sn / 1.2% Ag / 0.5% Cu / 0.05%
Flammability	Ni) : UL-V0
Thermal resistance(Theta Ja)	: 16 °C/W

3. Result Summary

Lifetime Simulation Tests	: Passed ELFR & HTOL
Environment Stress Tests	: Passed All Tests
ESD & Latch-up	: Passed HBM 2000V, CDM 500V & Latch-up ±200mA

3. Accelerated Lifetime Simulation Tests

Group	Test Item / Conditions	Test Method	Duration or Level	Result		Notes
				Number of Lots	Failed Q'ty / Tested Q'ty	
Accelerated Lifetime Simulation Tests	**Early Life Failure Rate** Grade 1 : 125°C, 2.05V Dynamic stress	AEC Q100-008	48 hours	3	0 / 2400 (Passed)	1, 2
	High Temperature Operating Life Grade 1 : 125°C, 2.05V Dynamic stress, Read cycling with CKBD pattern *Preconditioning : 10k Endurance test at high temperature*	AEC Q100-005	1000 hours	3	0 / 231 (Passed)	1, 2, 3, 4

Note :

1) All electrical tests at different temperatures are performed before and after each item based on AEC-Q100 Rev-H.
2) "Dynamic stress" means continuous memory operation like read or write function.
3) High temperature program/erase endurance cycling is performed as preconditioning before the test.
4) CKBD means "Checkerboard" pattern.

* Failure Rate Estimation

Estimation Condition :

User Operating Temperature : 55°C
User Operating Voltage : Worst case (Maximum Operating Voltage in the Datasheet)
Confidence Level : 60%

$AF_{OVERALL} = AF_T * AF_V = 77.9 * 2.2 = 173.5$

Early Life (Ea = 0.7 eV, β = 8) : 45.9 FITs
Inherent Life (Ea = 0.7 eV, β = 8) : 22.9 FITs

4. Accelerated Lifetime Simulation Tests (Endurance & Data Retention)

Group	Test Item / Conditions	Test Method	Duration or Level	Result		Notes
				Number of Lots	Failed Q'ty / Tested Q'ty	
Accelerated Lifetime Simulation Tests	**Endurance @ High Temperature** 85°C, 1.95V, Program/Read "0"/Erase/Read "1" cycling	AEC Q100-005 JESD22-A117	10k cycles	3	0 / 231 (Passed)	1
	High Temperature Data Retention 125°C, All bit cells programmed *Preconditioning : 10k Endurance test at high temperature above*		100 hours	3	0 / 231 (Passed)	1, 2
	Endurance @ High Temperature 85°C, 1.95V, Program/Read "0"/Erase/Read "1" cycling		100k cycles	3	0 / 231 (Passed)	1
	High Temperature Data Retention 125°C, All bit cells programmed *Preconditioning : 100k Endurance test at high temperature above*		10 hours	3	0 / 231 (Passed)	1, 3
	Endurance at Low Temperature 25°C, 1.95V, Program/Read "0"/Erase/Read "1" cycling		100k cycles	3	0 / 231 (Passed)	1
	Low Temperature Data Retention 25°C, All bit cells programmed *Preconditioning : 100k Endurance test at low temperature above*		1000 hours	3	0 / 231 (Passed)	1
	High Temperature Data Retention 125°C, All bit cells programmed *Preconditioning : 10k Endurance test at low temperature above*		100 hours	3	0 / 231 (Passed)	1

Note :

1) All electrical tests at different temperatures are performed before and after each item based on AEC-Q100 Rev-H.

2) 100 hours bake at 125°C temperature is equivalent to 10 years at 55°C.

3) 10 hours bake at 125°C temperature is equivalent to 1 year at 55°C.

5. Accelerated Environment Stress Tests

Group	Test Item / Conditions	Test Method	Duration or Level	Result		Notes
				Number of Lots	Failed Q'ty / Tested Q'ty	
Accelerated Environment Stress Tests	**Preconditioning** Bake : 125°C Soak : 30°C, 60% RH Reflow : 260°C	J-STD-020	Level 3 24 hours 192 hours 3 cycles	3	0 / 738 (Passed)	1
	Biased HAST 110°C, 85% RH, 1.95V(V_{CC} max)	JESD22-A110	264 hours	3	0 / 231 (Passed)	1, 2
	Unbiased HAST 110°C, 85% RH	JESD22-A118	264 hours	3	0 / 231 (Passed)	1, 2
	Temperature Cycling Grade 1 : -65℃ to 150℃	JESD22-A104	500 cycles	3	0 / 231 (Passed)	1, 2
	Power Temperature Cycling Grade 2 : -40°C to 105°C, 1.95V(V_{CC} max)	JESD22-A105	1000 cycles	1	0 / 45 (Passed)	1, 2
	High Temperature Storage Life Grade 2 : 150°C	JESD22-A103	500 hours	1	0 / 45 (Passed)	1

Note :

1) All electrical tests at different temperatures are performed before and after each item based on AEC-Q100 Rev-H.

2) Preconditioning is performed before the test.

6. Electrical Verification Tests (Electrostatic Discharge & Latch-up)

Group	Test Item / Conditions	Test Method	Duration or Level	Result		Notes
				Number of Lots	Failed Q'ty / Tested Q'ty	
Electrical Verification Tests	**ESD Human Body Model**	AEC Q100-002	500V	1	0 / 9 (Passed)	1, 2
	ESD Human Body Model		1000V	1	0 / 9 (Passed)	1, 2
	ESD Human Body Model		2000V	1	0 / 9 (Passed)	1, 2
	ESD Charged Device Model	AEC Q100-011	250V	1	0 / 3 (Passed)	1, 2
	ESD Charged Device Model		500V	1	0 / 3 (Passed)	1, 2
	Latch-Up (I-test) - Test at 105°C	AEC Q100-004	±200mA	1	0 / 6 (Passed)	1, 3
	Latch-Up (Overvoltage) - Test at 105°C		3V	1	0 / 3 (Passed)	1, 3

Note :

1) All electrical tests at different temperatures are performed before and after each item based on AEC-Q100 Rev-H.

2) HBM & CDM tests are performed at room temp.

3) Latch-up tests are performed at 105°C.