Q2, 2024 Quarterly Reliability Report

1. S34ML-1 product family, 41nm SLC NAND

41 nm SLC NAND were introduced in Jun 2012 and utilize tunnel Oxide, Polysilicon floating gate and interconnections are three metal layers with contact plugs and barrier metals. The 1st Metal layer for 41 nm SLC NAND is using Copper.

Data Summary and Failure Rate Estimation using Exponential Model HTOL Stress Temperature - 125°C

Failure Mechanisms	Read Point / Test Result		Modeling Parameters @ 55°C					Average Failure Rate	
	Early Life (hrs)	Inherent Life (hrs)	Ea eV	TAF	VAF	OAF	MTTF (yrs)	Early Life (PPM)	Inherent Life (FITS)
	96	1000							
Sample Size	500	150							
125C, Zero fails, Process ave. Ea	0	0	0.7	74	1	74	9259	0	4.74

Data Retention Bake - 150°C

Reliability Stress	Sample Size	Reject	PPM	FITS
1000	77	0	0	<1

Endurance - 90°C

Reliability Stress	Sample Size	Reject	PPM	FITS
10000	60	0	0	2
100000(Decade)	64	0	0	

2. S34ML-2 product family, 32nm SLC NAND

32 nm SLC NAND were introduced in October 2012 and utilize tunnel Oxide, Polysilicon floating gate and interconnections are three metal layers with contact plugs and barrier metals. The 1st Metal layer for 32 nm SLC NAND is using Copper

Data Summary and Failure Rate Estimation using Exponential Model HTOL Stress Temperature - 125°C

Failure Mechanisms	**Read Point / Test Result**		**Modeling Parameters @ 55°C**					**Average Failure Rate**	
	Early Life (hrs)	**Inherent Life (hrs)**	**Ea eV**	**TAF**	**VAF**	**OAF**	**MTTF (yrs)**	**Early Life (PPM)**	**Inherent Life (FITS)**
	96	**1000**							
Sample Size	500	150							
125C, Zero fails, Process ave. Ea	0	0	0.7	74	1	74	12198	0	3.11

Data Retention Bake - 150°C

Reliability Stress	**Sample Size**	**Reject**	**PPM**	**FITS**
1000	77	0	0	<1

Endurance - 90°C

Reliability Stress	**Sample Size**	**Reject**	**PPM**	**FITS**
10000	60	0	0	2
100000(Decade)	64	0	0	

3. S34/S35ML-3 product family, 16nm SLC NAND

16 nm SLC NAND were introduced in November 2019 and utilize tunnel Oxide, Polysilicon floating gate and interconnections are three metal layers with contact plugs and barrier metals. The 1st Metal layer for 16 nm SLC NAND is using Copper

Data Summary and Failure Rate Estimation using Exponential Model HTOL Stress Temperature - 125°C

	Read Point / Test Result		**Modeling Parameters @ 55°C**					**Average Failure Rate**	
Failure Mechanisms	**Early Life (hrs)**	**Inherent Life (hrs)**	**Ea eV**	**TAF**	**VAF**	**OAF**	**MTTF (yrs)**	**Early Life (PPM)**	**Inherent Life (FITS)**
	96	**1000**							
Sample Size	500	150							
125C, Zero fails, Process ave. Ea	0	0	0.66	61	1	62	5708	5.52	5.34

Data Retention Bake - 150°C

Reliability Stress	**Sample Size**	**Reject**	**PPM**	**FITS**
1000	77	0	0	<1

Endurance - 90°C

Reliability Stress	**Sample Size**	**Reject**	**PPM**	**FITS**
10000	60	0	0	2
100000(Decade)	64	0	0	

4. S40FC004 product family, 4GB eMMC

4GB eMMC were introduced in November 2020 and utilize tunnel Oxide, Polysilicon floating gate and interconnections are three metal layers with contact plugs and barrier metals. The 1st Metal layer for 16 nm MLC NAND is using Copper

Data Summary and Failure Rate Estimation using Exponential Model HTOL Stress Temperature - 125°C

Failure Mechanisms	Read Point / Test Result			Modeling Parameters @ 55°C					Average Failure Rate	
	Early Life (hrs)	Inherent Life (hrs)		Ea eV	TAF	VAF	OAF	MTTF (yrs)	Early Life (PPM)	Inherent Life (FITS)
	168	504	1000							
Sample Size	231	231	231							
125C, Zero fails, Process ave. Ea		0	0	0.7	61	1	62	3747	58.51	16.97

Data Retention Bake - 150°C

Reliability Stress	Sample Size	Reject	PPM	FITS
1000	77	0	0	<1

Endurance - 90°C

Reliability Stress	Sample Size	Reject	PPM	FITS
10000	60	0	0	2
100000(Decade)	64	0	0	

5. S40FC008 product family, 8GB eMMC

8GB eMMC were introduced in April 2022 and utilize tunnel Oxide, Polysilicon floating gate and interconnections are three metal layers with contact plugs and barrier metals. The 1st Metal layer for 16 nm MLC NAND is using Copper

Data Summary and Failure Rate Estimation using Exponential Model HTOL Stress Temperature - 125°C

Failure Mechanisms	Read Point / Test Result			Modeling Parameters @ 55°C					Average Failure Rate	
	Early Life (hrs)	Inherent Life (hrs)		Ea eV	TAF	VAF	OAF	MTTF (yrs)	Early Life (PPM)	Inherent Life (FITS)
	168	504	1000							
Sample Size	231	231	231							
125C, Zero fails, Process ave. Ea		0	0	0.7	61	1	62	3747	39.88	11.78

Data Retention Bake - 150°C

Reliability Stress	Sample Size	Reject	PPM	FITS
1000	77	0	0	<1

Endurance - 90°C

Reliability Stress	Sample Size	Reject	PPM	FITS
10000	60	0	0	2
100000(Decade)	64	0	0	

6. S40FC016 product family, 16GB eMMC

16GB eMMC were introduced in June 2023 and utilize tunnel Oxide, Polysilicon floating gate and interconnections are three metal layers with contact plugs and barrier metals. The 1st Metal layer for 14 nm MLC NAND is using Copper

Data Summary and Failure Rate Estimation using Exponential Model HTOL Stress Temperature - 125°C

Failure Mechanisms	Read Point / Test Result			Modeling Parameters @ 55°C					Average Failure Rate	
	Early Life (hrs)	Inherent Life (hrs)		Ea eV	TAF	VAF	OAF	MTTF (yrs)	Early Life (PPM)	Inherent Life (FITS)
	168	504	1000							
Sample Size	231	231	231							
125C, Zero fails, Process ave. Ea		0	0	0.7	61	1	62	3747	59.95	17.90

Data Retention Bake - 150°C

Reliability Stress	Sample Size	Reject	PPM	FITS
1000	77	0	0	<1

Endurance - 90°C

Reliability Stress	Sample Size	Reject	PPM	FITS
10000	60	0	0	2
100000(Decade)	64	0	0	

7. S6AA8803 product family, 8+8Gb MCP

8+8Gb MCP were introduced in July 2023 and utilize tunnel Oxide, Polysilicon floating gate and interconnections are three metal layers with contact plugs and barrier metals.

Data Summary and Failure Rate Estimation using Exponential Model HTOL Stress Temperature - 125°C

Failure Mechanisms	Read Point / Test Result			Modeling Parameters @ 55°C					Average Failure Rate	
	Early Life (hrs)	Inherent Life (hrs)		Ea eV	TAF	VAF	OAF	MTTF (yrs)	Early Life (PPM)	Inherent Life (FITS)
	168	504	1000							
Sample Size	231	231	231							
125C, Zero fails, Process ave. Ea		0	0	0.7	61	1	62	45,480	7.39	2.51

8. Data Summaries by Package Family

BGA 63 (Ball Grid Array)

Reliability Stress		Sample Size	Reject	Failure Rate PPM
HAST	96hrs	433	0	0
	264hrs	557	0	0
HIGH TEMP STORAGE	1000hrs	770	0	0
TEMP CYCLE	500cycle	563	0	0
	1000cycle	75	0	0
UNBIASED HAST TEST	96hrs	611	0	0
	264hrs	173	0	0

TSOP 48 (Thin Small Outline Package)

Reliability Stress		Sample Size	Reject	Failure Rate PPM
HAST	96hrs	490	0	0
	264hrs	120	0	0
HIGH TEMP STORAGE	1000hrs	847	0	0
PRESSURE COOKER TEST	96hrs	500	0	0
	168hrs	30	0	0
TEMP CYCLE	500cycle	490	0	0
UNBIASED HAST TEST	96hrs	435	0	0

BGA 153 (Ball Grid Array)

Reliability Stress		Sample Size	Reject	Failure Rate PPM
PC	192hrs	693	0	0
HAST	164hrs	231	0	0
HIGH TEMP STORAGE	1000hrs	231	0	0
TEMP CYCLE	500cycle	231	0	0
UNBIASED HAST TEST	96hrs	231	0	0

BGA 149 (Ball Grid Array)

Reliability Stress		Sample Size	Reject	Failure Rate PPM
PC	192hrs	693	0	0
HAST	164hrs	231	0	0
HIGH TEMP STORAGE	1000hrs	231	0	0
TEMP CYCLE	500cycle	231	0	0
UNBIASED HAST TEST	96hrs	231	0	0