6. Process Related Reliability Test Data

Dynamic Early Fail Rate (EFR)

1. Test Condition

Performed to accelerate infant mortality failure mechanisms within 1~3 years

Spec: Failure Rate < 300 ppm, Confidence Level: 60%

2. Dynamic RAM Products

Design Rule Technology	Period	Sample Size	No. of Failure/Failure Mode				Failure Rate (ppm)
			Total	Function	DC	Pause	
0.046μm CMOS/SPTM	Q2,13	13050	0	0	0	0	70
	Q3,13	14896	0	0	0	0	62
	Q4,13	15769	0	0	0	0	58
	Q1,14	23231	0	0	0	0	39
0.065μm CMOS/SPTM	Q2,13	17280	0	0	0	0	53
	Q3,13	16931	0	0	0	0	54
	Q4,13	15981	0	0	0	0	57
	Q1,14	18431	0	0	0	0	50

3. Non-Volatile Memory Products

Design Rule Technology	Period	Sample Size	No. of Failure/Failure Mode				Failure Rate (ppm)
			Total	Function	DC	DR	
0.058 μm CMOS/DPTM 3V Serial Flash	Q2,13	15592	0	0	0	0	59
	Q3,13	17000	0	0	0	0	54
	Q4,13	13000	0	0	0	0	71
	Q1,14	14000	0	0	0	0	65
0.09 μm CMOS/DPTM 3V Serial Flash	Q2,13	17168	0	0	0	0	53
	Q3,13	15000	0	0	0	0	61
	Q4,13	18000	0	0	0	0	51
	Q1,14	15000	0	0	0	0	61

0.09 μm CMOS/DPTM 1.8V Serial Flash	Q2,13	8000	0	0	0	0	115
	Q3,13	5000	0	0	0	0	183
	Q4,13	7000	0	0	0	0	131
	Q1,14	6000	0	0	0	0	152
0.09 μm CMOS/DPTM 3V Parallel Flash	Q2,13	4000	0	0	0	0	183
	Q3,13	3200	0	0	0	0	286
	Q4,13	3100	0	0	0	0	296
	Q1,14	3100	0	0	0	0	296

High-Temperature Operating Life Test (HTOL)

1. Test Condition

Condition: Dynamic operating condition with Vcc = 3.6V/2.7V/1.9V for 3.3V/2.5V/1.8V products, T = 125°C, f = 1.0 MHz/1.25 MHz/1.25 MHz for synchronous SDRAMs/DDR/DDRII

Dynamic operating condition with Vcc = 3.6V/1.95V for 3.3V/1.8V products, T = 125°C, f = 1 MHz for Nov-Volatile Memory

Duration: Test time points at 500 hrs, and 1000 hrs.

2. Dynamic RAM Products

2.1 By Device Type

Product Type	Part No.	Design Rule	Period	No. of Samples	No. of Fails	Reject Information
32M × 16 1.9V	W9751G6KB	0.046 µm	Q2,13	77	0	
			Q3,13	77	0	
			Q4,13	77	0	
			Q1,14	77	0	
4M × 16 3.3V	W9864G6KH	0.046 µm	Q2,13	-	-	
			Q3,13	-	-	
			Q4,13	-	-	
			Q1,14	77	0	
8M × 16 2.5V	W9812G6JH	0.065 µm	Q2,13	77	0	
			Q3,13	77	0	
			Q4,13	77	0	
			Q1,14	77	0	

2.2 By Process

Design Rule Technology	Period	No. of Samples	No. of Fails	Reject Information
0.046 µm CMOS/SPTM	Q2,13	77	0	
	Q3,13	77	0	
	Q4,13	77	0	
	Q1,14	154	0	

0.065 µm CMOS/SPTM	Q2,13	77	0	
	Q3,13	77	0	
	Q4,13	77	0	
	Q1,14	77	0	

3. Non-Volatile Memory Products

3.1 By Device Type

Product Type	Part No.	Design Rule	Period	No. of Samples	No. of Fails	Reject Information
64M, 3V SERIAL FLASH	W25Q64FV	0.058 µm	Q2,13	77	0	
			Q3,13	-	-	
			Q4,13	-	-	
			Q1,14	-	-	
32M, 3V SERIAL FLASH	W25Q32FV	0.058 µm	Q2,13	-	-	
			Q3,13	77	0	
			Q4,13	77	0	
			Q1,14	77	0	
4M, 3V SERIAL FLASH	W25Q40CV	0.09 um	Q2,13	77	0	
			Q3,13	77	0	
			Q4,13	77	0	
			Q1,14	77	0	
8M, 1.8V SERIAL FLASH	W25Q80BW	0.09 µm	Q2,13	77	0	
			Q3,13	77	0	
			Q4,13	77	0	
			Q1,14	77	0	
64M, 3V Parallel FLASH	W29GL64C	0.09 µm	Q2,13	77	0	
			Q3,13	77	0	
			Q4,13	77	0	
			Q1,14	77	0	

3.2 By Process

Design Rule Technology	Period	No. of Samples	No. of Fails	Reject Information
0.058 µm CMOS/DPTM 3V Serial Flash	Q2,13	77	0	
	Q3,13	77	0	
	Q4,13	77	0	
	Q1,14	77	0	
0.09 µm CMOS/DPTM 3V Serial Flash	Q2,13	77	0	
	Q3,13	77	0	
	Q4,13	77	0	
	Q1,14	77	0	
0.09 µm CMOS/DPTM 1.8V Serial Flash	Q2,13	77	0	
	Q3,13	77	0	
	Q4,13	77	0	
	Q1,14	77	0	
0.09 µm CMOS/DPTM 3V Parallel Flash	Q2,13	77	0	
	Q3,13	77	0	
	Q4,13	77	0	
	Q1,14	77	0	

High-Temperature Storage Life Test (HTSL)

1. Test Condition

Condition: T = 150°C

Duration: Test time points at 500 hrs, and 1000 hrs. (Need to do precondition)

2. Dynamic RAM Products

2.1 By Device Type

Product Type	Part No.	Design Rule	Period	No. of Samples	No. of Fails	Reject Information
32M × 16 1.9V	W951G6KB	0.046 µm	Q2,13	77	0	
			Q3,13	77	0	
			Q4,13	77	0	
			Q1,14	77	0	
4M × 16 3.3V	W9864G6KH	0.046 µm	Q2,13	-	-	
			Q3,13	-	-	
			Q4,13	-	-	
			Q1,14	77	0	
8M × 16 2.5V	W9812G6JH	0.065 µm	Q2,13	77	0	
			Q3,13	77	0	
			Q4,13	77	0	
			Q1,14	77	0	

2.2 By Process

Design Rule Technology	Period	No. of Samples	No. of Fails	Reject Information
0.046 µm CMOS/SPTM	Q2,13	77	0	
	Q3,13	77	0	
	Q4,13	77	0	
	Q1,14	154	0	
0.065 µm CMOS/SPTM	Q2,13	77	0	
	Q3,13	77	0	
	Q4,13	77	0	
	Q1,14	77	0	

3. Non-Volatile Memory Products

3.1 By Device Type

Product Type	Part No.	Design Rule	Period	No. of Samples	No. of Fails	Reject Information
64 M, 3V SERIAL FLASH	W25Q64FV	0.058 µm	Q2,13	77	0	
			Q3,13	-	-	
			Q4,13	-	-	
			Q1,14	-	-	
32 M, 3V SERIAL FLASH	W25Q32FV	0.058 µm	Q2,13	-	-	
			Q3,13	77	0	
			Q4,13	77	0	
			Q1,14	77	0	
4 M, 3V SERIAL FLASH	W25Q40CV	0.09 um	Q2,13	77	0	
			Q3,13	77	0	
			Q4,13	77	0	
			Q1,14	77	0	
8 M 1.8V SERIAL FLASH	W25Q80BW	0.09 µm	Q2,13	77	0	
			Q3,13	77	0	
			Q4,13	77	0	
			Q1,14	77	0	
64 M 3V Parallel FLASH	W29GL64C	0.09 µm	Q2,13	77	0	
			Q3,13	77	0	
			Q4,13	77	0	
			Q1,14	77	0	

3.2 By Process

Design Rule Technology	Period	No. of Samples	No. of Fails	Reject Information
0.058 µm CMOS/DPTM 3V Serial Flash	Q2,13	77	0	
	Q3,13	77	0	
	Q4,13	77	0	
	Q1,14	77	0	

0.09 µm CMOS/DPTM 3V Serial Flash	Q2,13	77	0	
	Q3,13	77	0	
	Q4,13	77	0	
	Q1,14	77	0	
0.09 µm CMOS/DPTM 1.8V Serial Flash	Q2,13	77	0	
	Q3,13	77	0	
	Q4,13	77	0	
	Q1,14	77	0	
0.09 µm CMOS/DPTM 3V Parallel Flash	Q2,13	77	0	
	Q3,13	77	0	
	Q4,13	77	0	
	Q1,14	77	0	

Data Retention Test (DR)

1. Test Condition

Condition: T = 150°C

Duration: Test time points at 500 hrs, and 1000 hrs.

2. Non-Volatile Memory Products

2.1 By Device Type

Product Type	Part No.	Design Rule	Period	No. of Samples	No. of Fails	Reject Information
64M, 3V SERIAL FLASH	W25Q64FV	0.058 μm	Q2,13	77	0	
			Q3,13	-	-	
			Q4,13	-	-	
			Q1,14	-	-	
32M, 3V SERIAL FLASH	W25Q32FV	0.058 μm	Q2,13	-	-	
			Q3,13	77	0	
			Q4,13	77	0	
			Q1,14	77	0	
4M, 3V SERIAL FLASH	W25Q40CV	0.09 μm	Q2,13	77	0	
			Q3,13	77	0	
			Q4,13	77	0	
			Q1,14	77	0	
8M 1.8V SERIAL FLASH	W25Q80BW	0.09 μm	Q2,13	77	0	
			Q3,13	77	0	
			Q4,13	77	0	
			Q1,14	77	0	
64M 3V Parallel FLASH	W29GL64C	0.09 μm	Q2,13	77	0	
			Q3,13	77	0	
			Q4,13	77	0	
			Q1,14	77	0	

2.2 By Process

Design Rule Technology	Period	No. of Samples	No. of Fails	Reject Information
0.058 µm CMOS/DPTM 3V Serial Flash	Q2,13	77	0	
	Q3,13	77	0	
	Q4,13	77	0	
	Q1,14	77	0	
0.09 µm CMOS/DPTM 3V Serial Flash	Q2,13	77	0	
	Q3,13	77	0	
	Q4,13	77	0	
	Q1,14	77	0	
0.09 µm CMOS/DPTM 1.8V Serial Flash	Q2,13	77	0	
	Q3,13	77	0	
	Q4,13	77	0	
	Q1,14	77	0	
0.09 µm CMOS/DPTM 3V Parallel Flash	Q2,13	77	0	
	Q3,13	77	0	
	Q4,13	77	0	
	Q1,14	77	0	

Endurance Cycling With Data Retention Test

Room Temperature cycling with DR

1. Test Condition

Condition: T = Room temperature, Vcc = 3.6V/1.95V for Endurance Cycling test, and
T = Room temperature ,Vcc = 3.6V/1.95V , f = 1 MHz for room temperature operation life test
Duration: 1K, 10K, 100K cycles for Endurance Cycling test
and 500 hrs for room temperature operation life test

2. Non-Volatile Memory Products

2.1 By Device Type

Product Type	Part No.	Design Rule	Period	No. of Samples	No. of Fails	Reject Information
64M, 3V SERIAL FLASH	W25Q64FV	0.058 μm	Q2,13	38	0	
			Q3,13	38	0	
			Q4,13	38	0	
			Q1,14	-	-	
32M, 3V SERIAL FLASH	W25Q32FV	0.058 μm	Q2,13	-	-	
			Q3,13	-	-	
			Q4,13	-	-	
			Q1,14	38	0	
4M, 3V SERIAL FLASH	W25Q40CV	0.09 μm	Q2,13	38	0	
			Q3,13	38	0	
			Q4,13	38	0	
			Q1,14	38	0	
8M, 1.8V SERIAL FLASH	W25Q80BW	0.09 μm	Q2,13	38	0	
			Q3,13	38	0	
			Q4,13	38	0	
			Q1,14	38	0	
64M, 3V Parallel FLASH	W29GL64C	0.09 μm	Q2,13	38	0	
			Q3,13	38	0	
			Q4,13	38	0	
			Q1,14	38	0	

2.2 By Process

Design Rule Technology	Period	No. of Samples	No. of Fails	Reject Information
0.058 µm CMOS/DPTM 3V Serial Flash	Q2,13	38	0	
	Q3,13	38	0	
	Q4,13	38	0	
	Q1,14	38	0	
0.09 µm CMOS/DPTM 3V Serial Flash	Q2,13	38	0	
	Q3,13	38	0	
	Q4,13	38	0	
	Q1,14	38	0	
0.09 µm CMOS/DPTM 1.8V Serial Flash	Q2,13	38	0	
	Q3,13	38	0	
	Q4,13	38	0	
	Q1,14	38	0	
0.09 µm CMOS/DPTM 3V Parallel Flash	Q2,13	38	0	
	Q3,13	38	0	
	Q4,13	38	0	
	Q1,14	38	0	

High Temperature cycling with DR

1. Test Condition

Condition: T = 85°C, Vcc = 3.6V/1.95V for Endurance Cycling test, and
T = 125°C for High Temperature Data Retention test
Duration: 1K, 10K, 100K cycles for Endurance Cycling test
and 100 hrs for High Temperature Data Retention test

2. Non-Volatile Memory Products

2.1 By Device Type

Product Type	Part No.	Design Rule	Period	No. of Samples	No. of Fails	Reject Information
64M, 3V SERIAL FLASH	W25Q64FV	0.058 µm	Q2,13	39	0	
			Q3,13	39	0	
			Q4,13	39	0	
			Q1,14	-	-	
32M, 3V SERIAL FLASH	W25Q32FV	0.058 µm	Q2,13	-	-	
			Q3,13	-	-	
			Q4,13	-	-	
			Q1,14	39	0	
4M, 3V SERIAL FLASH	W25Q40CV	0.09 µm	Q2,13	39	0	
			Q3,13	39	0	
			Q4,13	39	0	
			Q1,14	39	0	
8M, 1.8V SERIAL FLASH	W25Q80BW	0.09 µm	Q2,13	39	0	
			Q3,13	39	0	
			Q4,13	39	0	
			Q1,14	39	0	
64M, 3V Parallel FLASH	W29GL64C	0.09 µm	Q2,13	39	0	
			Q3,13	39	0	
			Q4,13	39	0	
			Q1,14	39	0	

2.2 By Process

Design Rule Technology	Period	No. of Samples	No. of Fails	Reject Information
0.058 µm CMOS/DPTM 3V Serial Flash	Q2,13	39	0	
	Q3,13	39	0	
	Q4,13	39	0	
	Q1,14	39	0	
0.09 µm CMOS/DPTM 3V Serial Flash	Q2,13	39	0	
	Q3,13	39	0	
	Q4,13	39	0	
	Q1,14	39	0	
0.09 µm CMOS/DPTM 1.8V Serial Flash	Q2,13	39	0	
	Q3,13	39	0	
	Q4,13	39	0	
	Q1,14	39	0	
0.09 µm CMOS/DPTM 3V Parallel Flash	Q2,13	39	0	
	Q3,13	39	0	
	Q4,13	39	0	
	Q1,14	39	0	

Electrostatic Discharge (ESD) Test

1. Test Condition

Human Body Mode.

According to JESD22-A114.

2. Dynamic RAM Products

Product Type	Design Rule (μm)	No. of DUT	Pass Voltage (HBM)
64M x 16 (1.9 V)	0.065	12	> 2 kV
16M x 16 (2.7 V)	0.065	12	> 2 kV
32M x 16 (1.8 V)	0.065	12	> 2 kV
16M x 16 (1.8 V)	0.065	12	> 2 kV
8M x 16 (2.7 V)	0.065	12	> 2 kV
8M x 16 (1.8 V)	0.065	12	> 2 kV
4M x 16 (2.7 V)	0.065	12	> 2 kV
64M x 16 (1.5 V)	0.046	12	> 2 kV
128M x 16 (1.5 V)	0.046	12	> 2 kV
32M x 16 (1.9 V)	0.046	12	> 2 kV
16M x 16 (1.9 V)	0.046	12	> 2 kV
8M x 16 (1.9 V)	0.046	12	> 2 kV
32M x 32 (1.9 V)	0.046	12	> 2 kV
16M x 32 (1.9 V, LP)	0.046	12	> 2 kV
32M x 32 (1.9 V, LP)	0.046	12	> 2 kV
8M x 32 (1.95 V, LP)	0.046	12	> 2 kV
16M x 32 (1.95 V, LP)	0.046	12	> 2 kV
32M x 32 (1.95 V, LP)	0.046	12	> 2 kV
64M x 32 (1.95 V, LP)	0.046	12	> 2 kV
64M x 16 (1.9 V)	0.046	12	> 2 kV
4M x 16 (2.7 V)	0.046	12	> 2 kV
8M x 16 (2.7 V)	0.046	12	> 2 kV
4M x 16 (1.98 V)	0.046	12	> 2 kV

3. Non-Volatile Memory Products

Product Type	Design Rule (μm)	No. of DUT	Pass Voltage (HBM)
256M SERIAL FLASH (3V)	0.058	12	> 2 kV
128M SERIAL FLASH (3V)	0.058	12	> 2 kV
64M SERIAL FLASH (3V)	0.058	12	> 2 kV
32M SERIAL FLASH (3V)	0.058	12	> 2 kV
128M SERIAL FLASH(1.8V)	0.058	12	> 2 kV
64M SERIAL FLASH (1.8V)	0.058	12	> 2 kV
32M SERIAL FLASH (1.8V)	0.058	12	> 2 kV
4M SERIAL FLASH (3V)	0.09	12	> 2 kV
8M SERIAL FLASH (3V)	0.09	12	> 2 kV
16M SERIAL FLASH (3V)	0.09	12	> 2 kV
32M SERIAL FLASH (3V)	0.09	12	> 2 kV
64M SERIAL FLASH (3V)	0.09	12	> 2 kV
128M SERIAL FLASH (3V)	0.09	12	> 2 kV
4M SERIAL FLASH (1.8V)	0.09	12	> 2 kV
8M SERIAL FLASH (1.8V)	0.09	12	> 2 kV
16M SERIAL FLASH(1.8V)	0.09	12	> 2 kV
32M SERIAL FLASH(1.8V)	0.09	12	> 2 kV
64M SERIAL FLASH(1.8V)	0.09	12	> 2 kV
32M Parallel FLASH(3V)	0.09	12	> 2 kV
64M Parallel FLASH(3V)	0.09	12	> 2 kV
128M Parallel FLASH(3V)	0.09	12	> 2 kV

Latch-Up Test

1. Test Condition

According to JEDEC -78.

2. Dynamic RAM Products

Product Type	Design Rule (μm)	No. of DUT	Pass Current
4M x 16 (3.6 V)	0.09	6	> 200 mA
16M x 16 (3.6 V)	0.09	6	> 200 mA
4M x 32 (3.6 V)	0.09	6	> 200 mA
64M x 16 (1.9 V)	0.065	6	> 200 mA
16M x 16 (2.7 V)	0.065	6	> 200 mA
32M x 16 (1.8 V)	0.065	6	> 200 mA
16M x 16 (1.8 V)	0.065	6	> 200 mA
8M x 16 (2.7 V)	0.065	6	> 200 mA
8M x 16 (1.8 V)	0.065	6	>200 mA
4M x 16 (2.7 V)	0.065	6	> 200 mA
64M x 16 (1.5 V)	0.046	6	>200 mA
128M x 16 (1.5 V)	0.046	6	>200 mA
32M x 16 (1.9 V)	0.046	6	>200 mA
16M x 16 (1.9 V)	0.046	6	>200 mA
8M x 16 (1.9 V)	0.046	6	>200 mA
32M x 32 (1.9 V)	0.046	6	>200 mA
16M x 32 (1.9 V, LP)	0.046	6	>200 mA
32M x 32 (1.9 V, LP)	0.046	6	>200 mA
8M x 32 (1.95 V, LP)	0.046	6	>200 mA
16M x 32 (1.95 V, LP)	0.046	6	>200 mA
32M x 32 (1.95 V, LP)	0.046	6	>200 mA
64M x 32 (1.95 V, LP)	0.046	6	>200 mA
64M x 16 (1.9 V)	0.046	6	>200 mA
4M x 16 (2.7 V)	0.046	6	>200 mA
8M x 16 (2.7 V)	0.046	6	>200 mA
4M x 16 (1.98 V)	0.046	6	>200 mA

3. Non-Volatile Memory Products

Product Type	Design Rule (μm)	No. of DUT	Pass Voltage
256M SERIAL FLASH (3V)	0.058	6	> 200 mA
128M SERIAL FLASH (3V)	0.058	6	> 200 mA
64M SERIAL FLASH (3V)	0.058	6	> 200 mA
32M SERIAL FLASH (3V)	0.058	6	> 200 mA
128M SERIAL (FLASH(1.8V)	0.058	6	> 200 mA
64M SERIAL FLASH (1.8V)	0.058	6	> 200 mA
32M SERIAL FLASH (1.8V)	0.058	6	> 200 mA
4M SERIAL FLASH (3V)	0.09	6	> 200 mA
8M SERIAL FLASH (3V)	0.09	6	> 200 mA
16M SERIAL FLASH (3V)	0.09	6	> 200 mA
32M SERIAL FLASH (3V)	0.09	6	> 200 mA
64M SERIAL FLASH (3V)	0.09	6	> 200 mA
128M SERIAL FLASH (3V)	0.09	6	> 200 mA
4M SERIAL FLASH (1.8V)	0.09	6	>200 mA
8M SERIAL FLASH (1.8V)	0.09	6	> 200 mA
16M SERIAL FLASH(1.8V)	0.09	6	> 200 mA
32M SERIAL FLASH(1.8V)	0.09	6	> 200 mA
64M SERIAL FLASH(1.8V)	0.09	6	> 200 mA
32M Parallel FLASH (3V)	0.09	6	> 200 mA
64M Parallel FLASH (3V)	0.09	6	> 200 mA
128M Parallel FLASH (3V)	0.09	6	> 200 mA