6. Process Related Reliability Test Data

Dynamic Early Fail Rate (EFR)

1. Test Condition

Condition: Dynamic operating condition with EFR voltage.

Duration: 5 hrs for DRAM and 72 hrs for Flash.

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	
0.065μm CMOS/SPTM	Q3,11	14862	0	0	0	0	61
	Q4,11	14618	0	0	0	0	63
	Q1,12	14040	0	0	0	0	65

3. Non-Volatile Memory Products

Design Rule Technology	Period	Sample Size	No. of Failure/Failure Mode				Failure Rate (ppm)
			Total	Function	DC	DR	
0.09 μm CMOS/DPTM 3V Serial Flash	Q3,11	16148	0	0	0	0	57
	Q4,11	15370	0	0	0	0	60
	Q1,12	19300	0	0	0	0	48
0.09 μm CMOS/DPTM 1.8V Serial Flash	Q3,11	3000	0	0	0	0	305
	Q4,11	4160	0	0	0	0	220
	Q1,12	3100	0	0	0	0	295
0.09 μm CMOS/DPTM 3V Parallel Flash	Q3,11	-	-	-	-	-	-
	Q4,11	-	-	-	-	-	-
	Q1,12	3112	0	0	0	0	294

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 168 hrs, 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
16M × 16 1.8V	W948D2FBJX	0.065 µm	Q3,11	77	0	
			Q4,11	-	-	
			Q1,12	-	-	
64M × 16 1.8V	W971GG6JB25A	0.065 µm	Q3,11	77	0	
			Q4,11	77	0	
			Q1,12	77	0	

2.2 By Process

Design Rule Technology	Period	No. of Samples	No. of Fails	Reject Information
0.065 µm CMOS/SPTM	Q3,11	154	0	
	Q4,11	77	0	
	Q1,12	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
128M, 3V SERIAL FLASH	W25Q128BV	0.09 µm	Q3,11	77	0	
			Q4,11	77	0	
			Q1,12	77	0	
8M, 1.8V SERIAL FLASH	W25Q80BW	0.09 µm	Q3,11	77	0	
			Q4,11	77	0	
			Q1,12	77	0	
64M, 3V Parallel FLASH	W29GL64C	0.09 µm	Q3,11	-	-	
			Q4,11	-	-	
			Q1,12	77	0	

3.2 By Process

Design Rule Technology	Period	No. of Samples	No. of Fails	Reject Information
0.09 µm CMOS/DPTM 3V Serial Flash	Q3,11	77	0	
	Q4,11	77	0	
	Q1,12	77	0	
0.09 µm CMOS/DPTM 1.8V Serial Flash	Q3,11	77	0	
	Q4,11	77	0	
	Q1,12	77	0	
0.09 µm CMOS/DPTM 3V Parallel Flash	Q3,11	-	-	
	Q4,11	-	-	
	Q1,12	77	0	

High-Temperature Storage Life Test (HTSL)

1. Test Condition

Condition: T = 150°C

Duration: Test time points at 168 hrs, 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
16M × 16 1.8V	W948D2FBJX	0.065 µm	Q3,11	77	0	
			Q4,11	-	-	
			Q1,12	-	-	
64M × 16 1.8V	W971GG6JB25A	0.065 µm	Q3,11	77	0	
			Q4,11	77	0	
			Q1,12	77	0	

2.2 By Process

Design Rule Technology	Period	No. of Samples	No. of Fails	Reject Information
0.065 µm CMOS/SPTM	Q3,11	154	0	
	Q4,11	77	0	
	Q1,12	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
128 M, 3V SERIAL FLASH	W25Q128BV	0.09 µm	Q3,11	77	0	
			Q4,11	77	0	
			Q1,12	77	0	
8 M 1.8V SERIAL FLASH	W25Q80BW	0.09 µm	Q3,11	77	0	
			Q4,11	77	0	
			Q1,12	77	0	
64 M 3V Parallel FLASH	W29GL64C	0.09 µm	Q3,11	-	-	
			Q4,11	-	-	
			Q1,12	77	0	

3.2 By Process

Design Rule Technology	Period	No. of Samples	No. of Fails	Reject Information
0.09 µm CMOS/DPTM 3V Serial Flash	Q3,11	77	0	
	Q4,11	77	0	
	Q1,12	77	0	
0.09 µm CMOS/DPTM 1.8V Serial Flash	Q3,11	77	0	
	Q4,11	77	0	
	Q1,12	77	0	
0.09 µm CMOS/DPTM 3V Parallel Flash	Q3,11	-	-	
	Q4,11	-	-	
	Q1,12	77	0	

Data Retention Test (DR)

1. Test Condition

Condition: T = 150°C

Duration: Test time points at 168 hrs, 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
128M, 3V SERIAL FLASH	W25Q128BV	0.09 µm	Q3,11	77	0	
			Q4,11	77	0	
			Q1,12	77	0	
8M 1.8V SERIAL FLASH	W25Q80BW	0.09 µm	Q3,11	77	0	
			Q4,11	77	0	
			Q1,12	77	0	
64M 3V Parallel FLASH	W29GL64C	0.09 µm	Q3,11	-	-	
			Q4,11	-	-	
			Q1,12	77	0	

2.2 By Process

Design Rule Technology	Period	No. of Samples	No. of Fails	Reject Information
0.09 µm CMOS/DPTM 3V Serial Flash	Q3,11	77	0	
	Q4,11	77	0	
	Q1,12	77	0	
0.09 µm CMOS/DPTM 1.8V Serial Flash	Q3,11	77	0	
	Q4,11	77	0	
	Q1,12	77	0	
0.09 µm CMOS/DPTM 3V Parallel Flash	Q3,11	-	-	
	Q4,11	-	-	
	Q1,12	77	0	

Endurance Cycling With Data Retention Test

Room Temperature cycling with DR

1. Test Condition

Condition: T = Room temperature, Vcc = 2.7V/1.65V 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 on 100:10:1 memory size 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
128M, 3V SERIAL FLASH	W25Q128BV	0.09 µm	Q3,11	38	0	
			Q4,11	38	0	
			Q1,12	38	0	
8M, 1.8V SERIAL FLASH	W25Q80BW	0.09 µm	Q3,11	38	0	
			Q4,11	38	0	
			Q1,12	38	0	
64M, 3V Parallel FLASH	W29GL64C	0.09 µm	Q3,11	-	-	
			Q4,11	-	-	
			Q1,12	38	0	

2.2 By Process

Design Rule Technology	Period	No. of Samples	No. of Fails	Reject Information
0.09 µm CMOS/DPTM 3V Serial Flash	Q3,11	38	0	
	Q4,11	38	0	
	Q1,12	38	0	
0.09 µm CMOS/DPTM 1.8V Serial Flash	Q3,11	38	0	
	Q4,11	38	0	
	Q1,12	38	0	
0.09 µm CMOS/DPTM 3V Parallel Flash	Q3,11	-	-	
	Q4,11	-	-	
	Q1,12	38	0	

High Temperature cycling with DR

1. Test Condition

Condition: T = 85°C, Vcc = 2.7V/1.65V for Endurance Cycling test, and
T = 125°C for High Temperature Data Retention test

Duration: 1K, 10K, 100K cycles on 100:10:1 memory size 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
128M, 3V SERIAL FLASH	W25Q128BV	0.09 µm	Q3,11	39	0	
			Q4,11	39	0	
			Q1,12	39	0	
8M, 1.8V SERIAL FLASH	W25Q80BW	0.09 µm	Q3,11	39	0	
			Q4,11	39	0	
			Q1,12	39	0	
64M, 3V Parallel FLASH	W29GL64C	0.09 µm	Q3,11	-	-	
			Q4,11	-	-	
			Q1,12	39	0	

2.2 By Process

Design Rule Technology	Period	No. of Samples	No. of Fails	Reject Information
0.09 µm CMOS/DPTM 3V Serial Flash	Q3,11	39	0	
	Q4,11	39	0	
	Q1,12	39	0	
0.09 µm CMOS/DPTM 1.8V Serial Flash	Q3,11	39	0	
	Q4,11	39	0	
	Q1,12	39	0	
0.09 µm CMOS/DPTM 3V Parallel Flash	Q3,11	-	-	
	Q4,11	-	-	
	Q1,12	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)
4M x 16 (3.6 V)	0.09	24	> 2 kV
16M x 16 (3.6 V)	0.09	24	> 2 kV
4M x 32 (3.6 V)	0.09	24	> 2 kV
64M x 16 (1.9 V)	0.065	24	> 2 kV
16M x 16 (2.7 V)	0.065	24	> 2 kV
32M x 16 (1.8 V)	0.065	24	> 2 kV
16M x 16 (1.8 V)	0.065	24	> 2 kV
8M x 16 (2.7 V)	0.065	24	> 2 kV
8M x 16 (1.8 V)	0.065	24	> 2 kV
4M x 16 (2.7 V)	0.065	24	> 2 kV

3. Non-Volatile Memory Products

Product Type	Design Rule (μm)	No. of DUT	Pass Voltage (HBM)
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	> 100 mA
16M x 16 (3.6 V)	0.09	6	> 100 mA
4M x 32 (3.6 V)	0.09	6	> 100 mA
64M x 16 (1.9 V)	0.065	6	> 100 mA
16M x 16 (2.7 V)	0.065	6	> 100 mA
32M x 16 (1.8 V)	0.065	6	> 100 mA
16M x 16 (1.8 V)	0.065	6	> 100 mA
8M x 16 (2.7 V)	0.065	6	> 100 mA
8M x 16 (1.8 V)	0.065	6	> 100 mA
4M x 16 (2.7 V)	0.065	6	> 100 mA

3. Non-Volatile Memory Products

Product Type	Design Rule (μm)	No. of DUT	Pass Voltage
4M SERIAL FLASH (3V)	0.09	6	> 100 mA
8M SERIAL FLASH (3V)	0.09	6	> 100 mA
16M SERIAL FLASH (3V)	0.09	6	> 100 mA
32M SERIAL FLASH (3V)	0.09	6	> 100 mA
64M SERIAL FLASH (3V)	0.09	6	> 100 mA
128M SERIAL FLASH (3V)	0.09	6	> 100 mA
4M SERIAL FLASH (1.8V)	0.09	6	> 100 mA
8M SERIAL FLASH (1.8V)	0.09	6	> 100 mA
16M SERIAL FLASH(1.8V)	0.09	6	> 100 mA
32M SERIAL FLASH(1.8V)	0.09	6	> 100 mA
64M SERIAL FLASH(1.8V)	0.09	6	> 100 mA
32M Parallel FLASH (3V)	0.09	6	> 100 mA

64M Parallel FLASH (3V)	0.09	6	> 100 mA
128M Parallel FLASH (3V)	0.09	6	> 100 mA