

8.1 Device Reliability Test Data – FLASH

Hot Carrier Effect Test

1. Flash Processes

1.1 58nm / 3.3V WinStack DPTM Flash Process (F05811A)

Lot No	Device Type	Life Time (Years)	Pass/Fail
6028AY200	NL W/L=10/0.3	1.29E+03	Pass
	NH W/L=10/0.60	7.66E+05	Pass
	PL W/L=10/0.35	3.31E+10	Pass
	PH W/L=10/0.60	2.03E+14	Pass
6028AY2AK	NL W/L=10/0.3	1.01E+03	Pass
	NH W/L=10/0.60	4.37E+04	Pass
	PL W/L=10/0.35	1.68E+11	Pass
	PH W/L=10/0.60	4.47E+12	Pass
6028AX1AW	NL W/L=10/0.3	7.88E+02	Pass
	NH W/L=10/0.60	9.12E+04	Pass
	PL W/L=10/0.35	4.80E+09	Pass
	PH W/L=10/0.60	1.85E+11	Pass

1.2 90nm / 3.3V WinStack DPTM Flash Process (F09810A)

Lot No	Device Type	Life Time (Years)	Pass/Fail
681982400	NL W/L=10/0.3	2.03E+05	Pass
	NH W/L=10/0.45	2.63E+04	Pass
	PL W/L=10/0.35	6.64E+14	Pass
	PH W/L=10/0.45	1.10E+15	Pass
68239D200	NL W/L=10/0.3	1.28E+05	Pass
	NH W/L=10/0.45	9.86E+05	Pass
	PL W/L=10/0.35	1.27E+14	Pass
	PH W/L=10/0.45	6.04E+16	Pass

68339H700	NL W/L=10/0.3	5.68E+04	Pass
	NH W/L=10/0.45	2.23E+05	Pass
	PL W/L=10/0.35	2.61E+14	Pass
	PH W/L=10/0.45	6.07E+16	Pass

Electromigration

1. Flash Process

1.1 58nm / 3.3V WinStack DPTM Flash Process (F05811A)

Structure	M1	M2	M3	V2	V3
1 st lot	>1000 Khrs	>1000 Khrs	2.59E+03 Khrs	7.41E+02 Khrs	5.88E+03 Khrs
2 nd lot	>1000 Khrs	>1000 Khrs	2.14E+03 Khrs	3.62E+02 Khrs	6.31E+03 Khrs
3 rd lot	>1000 Khrs	>1000 Khrs	1.51E+03 Khrs	3.64E+02 Khrs	3.37E+03 Khrs

1.2 90nm / 3.3V WinStack DPTM Flash Process (F09810A)

Structure	M1	M2	M3	V2	V3
1 st lot	3.13E+02 Khrs	3.48E+03 Khrs	2.87E+02 Khrs	4.29E+02 Khrs	1.06E+02 Khrs
2 nd lot	1.22E+02 Khrs	3.48E+03 Khrs	2.61E+02 Khrs	1.08E+03 Khrs	6.67E+02 Khrs
3 rd lot	1.16E+02 Khrs	5.47E+03 Khrs	1.69E+02 Khrs	7.60E+02 Khrs	5.10E+02 Khrs

SM: Pass. There is no samples with $\Delta R > 10\%$ after 1000hrs stress @250 C.

TDDDB Test

1. Flash Processes

1.1 58nm / 3.3V WinStack DPTM Flash Process (F05811A)

Lot No	Device Type	Life Time (Years)	Pass/Fail
6028AY200	NL 75A	1.24E+03	Pass
	NH 155A	7.08E+08	Pass
	PL 75 A	6.03E+02	Pass
	PH 155A	1.53E+07	Pass
6028AY2AK	NL 75A	9.04E+02	Pass
	NH 155A	3.79E+09	Pass
	PL 75 A	9.23E+03	Pass
	PH 155A	1.11E+08	Pass
6028AX1AW	NL 75A	4.21E+02	Pass
	NH 155A	1.29E+07	Pass
	PL 75 A	9.93E+02	Pass
	PH 155A	4.21E+09	Pass

1.2 90nm / 3.3V WinStack DPTM Flash Process (F09810A)

Lot No	Device Type	Life Time (Years)	Pass/Fail
681892400	NL 65A	5.46E+03	Pass
	NH 147A	1.69E+09	Pass
	PL 65 A	1.65E+04	Pass
	PH 147A	8.99E+10	Pass
68239D200	NL 65A	8.92E+02	Pass
	NH 147A	2.92E+09	Pass
	PL 65 A	8.02E+02	Pass
	PH 147A	6.29E+09	Pass
68339H700	NL 65A	3.37E+02	Pass
	NH 147A	8.60E+08	Pass
	PL 65 A	2.61E+02	Pass
	PH 147A	1.14E+08	Pass

NBTI Test

1. Flash Processes

1.1 58 nm / 3.3V WinStack DPTM Flash Process (F05811A)

Lot No	Device Type	Life Time (Years)	Pass/Fail
6028AY200	PL W/L=10/0.35	5.22E+03	Pass
	PH W/L=10/0.60	1.32E+03	Pass
6028AY2AK	PL W/L=10/0.35	6.52E+03	Pass
	PH W/L=10/0.60	1.81E+03	Pass
6028AX1AW	PL W/L=10/0.35	1.13E+05	Pass
	PH W/L=10/0.60	3.97E+03	Pass

1.2 90nm / 3.3V WinStack DPTM Flash Process (F09810A)

Lot No	Device Type	Life Time (Years)	Pass/Fail
681982400	NL W/L=10/0.3	1.64E+20	Pass
	NH W/L=10/0.45	4.53E+48	Pass
	PL W/L=10/0.35	8.85E+01	Pass
	PH W/L=10/0.45	2.38E+07	Pass
68239D200	NL W/L=10/0.3	1.34E+20	Pass
	NH W/L=10/0.45	3.53E+42	Pass
	PL W/L=10/0.35	9.83E+02	Pass
	PH W/L=10/0.45	7.08E+04	Pass
68339H700	NL W/L=10/0.3	1.40E+20	Pass
	NH W/L=10/0.45	6.51E+49	Pass
	PL W/L=10/0.35	3.58E+02	Pass
	PH W/L=10/0.45	1.36E+05	Pass

8.2 Device Reliability Test Data – DRAM

8.2.1 90nm Process: 300 mm FAB

1. TDDB

(years)	NWell		PWell		Cell	On film	On film	Pass/ Fail
	nf	nflo	Pf	Pflok				
						512M	128M	
1 st Qual.	1.42E+08	2.05E+05	3.09E+05	1.03E+05	2.09E+04	1.39E+04	1.51E+04	Pass
2 nd Qual.	6.16E+07	1.03E+05	1.64E+06	4.68E+05	1.17E+04	2.69E+04	6.60E+04	Pass
3 rd Qual.	1.16E+07	9.50E+04	8.46E+05	1.89E+05	1.67E+04	1.17E+06	2.43E+06	Pass

2. HCE:

AC(years)	NFET			NFET			Pass/ Fail
	nf	nf	nf	nl	nl	nlk	
	L=0.13	L=0.15	L=0.18	L=0.16	L=0.21	L=0.145	
1 st Qual.	2.42E+03	1.95E+04	2.09E+04	1.69E+06	2.15E+06	8.91E+04	Pass
2 nd Qual.	2.38E+03	1.56E+04	2.27E+04	7.97E+05	2.20E+06	4.84E+04	Pass
3 rd Qual.	1.90E+03	2.57E+04	2.24E+04	9.39E+05	2.11E+06	5.07E+04	Pass

(years)	NFET		PFET				Pass/ Fail
	nlk	nlk	pf	pf	pf	pflo	
	L=0.165	L=0.23	L=0.14	L=0.16	L=0.21	L=0.14	
1 st Qual.	1.43E+09	4.89E+01	5.37E+50	7.42E+55	7.29E+55	2.51E+47	Pass
2 nd Qual.	8.33E+09	4.41E+01	6.07E+52	8.48E+55	7.59E+55	3.90E+47	Pass
3 rd Qual.	5.78E+10	7.44E+01	5.12E+44	2.31E+53	1.96E+54	9.94E+44	Pass

(years)	PFET			PFET			Pass/ Fail
	pflo	pflok	pflok	pflok	pflok	pflok	
	L=0.30	L=0.18	L=0.2	L=0.22	L=0.23	L=0.31	
1 st Qual.	3.20E+63	2.95E+04	1.64E+05	2.26E+06	4.20E+07	3.17E+09	Pass
2 nd Qual.	6.80E+59	2.31E+04	1.03E+05	1.17E+06	3.26E+07	3.14E+09	Pass
3 rd Qual.	1.53E+54	1.93E+04	1.02E+05	1.13E+06	2.22E+07	2.35E+09	Pass

3. BT:

DC(years)	Pf	Pf	Pftklo	Pftklo	Pass/ Fail
	L=0.14	L=2.0	L=0.18	L=2.0	Fail
1 st Qual.	4.00E+28	4.65E+07	1.75E+39	1.12E+35	Pass
2 nd Qual.	3.11E+34	6.05E+10	3.29E+22	1.83E+34	Pass
3 rd Qual.	2.93E+21	9.47E+06	3.32E+31	1.24E+27	Pass

4. EM:

Lot	Structure	Ea	n	Stress	Condition	Lifetime	Pass / Fail
				T (C)	Current (mA)	(Hours)	
Lot#1	C1_us_230 M1	0.81	2.211	235	2.944	1.62E+06	Pass
	C1C2_us_380 M2	0.70	1.942	235	5.168	2.37E+05	Pass
	C1C2_us_860 M2	0.74	2.218	235	51.17	5.88E+07	Pass
	C1_us_230 C1	0.97	1.829	235	0.252	8.56E+05	Pass
	C1C2_us_380_C2	0.94	1.522	235	0.484	4.79E+06	Pass
	C1C2_us_860 C2	0.91	1.546	235	1.742	3.15E+07	Pass
Lot#2	C1_us_230 M1	0.81	2.211	235	2.944	1.86E+06	Pass
	C1C2_us_380 M2	0.70	1.942	235	5.168	2.38E+05	Pass
	C1C2_us_860 M2	0.74	2.218	235	51.17	6.06E+07	Pass
	C1_us_230 C1	0.97	1.829	235	0.252	8.53E+05	Pass
	C1C2_us_380_C2	0.94	1.522	235	0.484	4.83E+06	Pass
	C1C2_us_860 C2	0.91	1.546	235	1.742	3.22E+07	Pass
Lot#3	C1_us_230 M1	0.81	2.211	235	2.944	1.91E+06	Pass
	C1C2_us_380 M2	0.70	1.942	235	5.168	2.84E+05	Pass
	C1C2_us_860 M2	0.74	2.218	235	51.17	6.18E+07	Pass
	C1_us_230 C1	0.97	1.829	235	0.252	8.59E+05	Pass
	C1C2_us_380_C2	0.94	1.522	235	0.484	4.83E+06	Pass
	C1C2_us_860 C2	0.91	1.546	235	1.742	3.24E+07	Pass

5. SM: Pass. There is no samples with $\Delta R > 10\%$ after 1000hrs stress @250C.

8.2.2 65nm Process: 300 mm FAB

1. TDDDB

(years)							Pass/ Fail
	Ntn	Ntk	Ptn	Ptk	Array	CAP	
1 st Qual.	3.83E+04	2.46E+02	7.47E+02	8.96E+01	1.99E+03	1.83E+02	Pass
2 nd Qual.	4.64E+02	6.11E+02	8.84E+02	3.79E+01	4.02E+02	4.39E+03	Pass
3 rd Qual.	3.12E+02	3.27E+02	3.05E+02	2.34E+01	2.14E+02	4.30E+03	Pass

2. HCE:

AC(years)	NFET			NFET			Pass/ Fail
	nf	nf	nf	nflo	nflo	nflo	
	L=0.08	L=0.10	L=0.14	L=0.10	L=0.12	L=0.15	
1 st Qual.	3.61E+05	3.40E+05	2.02E+10	1.37E+05	1.44E+10	3.63E+15	Pass
2 nd Qual.	2.39E+05	1.10E+06	3.62E+07	1.93E+07	2.74E+15	1.12E+20	Pass
3 rd Qual.	3.21E+05	1.07E+07	3.22E+12	6.05E+09	3.49E+09	7.10E+11	Pass

AC(years)	NFET				NFET			Pass/ Fail
	nflotk	nflotk	nflotk	nflotk	nftk	nftk	nftk	
	L=0.14	L=0.16	L=0.20	L=0.30	L=0.16	L=0.21	L=0.30	
1 st Qual.	>4.38E+01	>1.04E+03	6.21E+06	7.45E+09	>2.63E+01	6.46E+03	9.20E+05	Pass
2 nd Qual.	>1.59E+01	>1.31E+03	2.33E+06	1.31E+08	>4.14E+01	4.43E+03	2.76E+05	Pass
3 rd Qual.	>2.52E+01	>2.05E+03	1.68E+06	9.85E+07	>5.21E+02	5.29E+03	7.20E+04	Pass

(years)	PFET			PFET			Pass/ Fail
	pf	pf	pf	pflo	pflo	pflo	
	L=0.08	L=0.10	L=0.14	L=0.10	L=0.12	L=0.14	
1 st Qual.	1.60E+09	7.18E+06	6.74E+09	3.03E+07	4.13E+04	7.58E+12	Pass
2 nd Qual.	5.21E+07	3.97E+07	1.97E+06	1.50E+05	5.61E+02	6.19E+09	Pass
3 rd Qual.	9.35E+05	1.09E+05	3.85E+07	2.10E+05	3.94E+03	1.76E+06	Pass

(years)	PFET				PFET				Pass/ Fail
	pflotk	pflotk	pflotk	pflotk	pftk	pftk	pftk	pftk	
	L=0.14	L=0.16	L=0.21	L=0.30	L=0.14	L=0.16	L=0.21	L=0.30	
1 st Qual.	>6.07E+05	>9.19E+05	1.29E+08	1.51E+05	>6.16E+05	>6.73E+04	3.18E+02	9.60E+07	Pass
2 nd Qual.	>4.68E+05	>2.00E+06	1.46E+08	6.32E+05	>2.20E+05	>1.01E+05	1.59E+04	3.71E+06	Pass
3 rd Qual.	>5.90E+05	>6.76E+06	1.32E+07	4.14E+05	>4.38E+05	>1.55E+05	3.23E+04	1.21E+07	Pass

3. BT:

DC(years)	Pf	Pftk	Pass/ Fail
	L=0.08	L=0.14	
1 st Qual.	5.87E+01	1.51E+02	Pass
2 nd Qual.	2.80E+01	2.99E+01	Pass
3 rd Qual.	7.29E+01	8.87E+01	Pass

4. EM:

Lot	Structure	Ea	n	Stress	Condition	Lifetime	Pass / Fail
				T (C)	Current (mA)	(Hours)	
Lot#1	C1_us_110 M1	0.80	2.015	235	0.385	1.76E+05	Pass
	CL_us_250 ML	0.93	1.485	235	4.250	3.27E+05	Pass
	C1_us_110 C1	0.83	2.203	235	0.320	3.24E+05	Pass
	CL_us_250 CL	0.94	2.140	235	0.588	5.48E+05	Pass
Lot#2	C1_us_110 M1	0.80	2.015	235	0.385	2.10E+05	Pass
	CL_us_250 ML	0.93	1.485	235	4.250	3.25E+05	Pass
	C1_us_110 C1	0.83	2.203	235	0.320	3.50E+05	Pass
	CL_us_250 CL	0.94	2.140	235	0.588	5.44E+05	Pass
Lot#3	C1_us_110 M1	0.80	2.015	235	0.385	2.16E+05	Pass
	CL_us_250 ML	0.93	1.485	235	4.250	3.90E+05	Pass
	C1_us_110 C1	0.83	2.203	235	0.320	4.06E+05	Pass
	CL_us_250 CL	0.94	2.140	235	0.588	6.05E+05	Pass

5. SM: Pass. There is no samples with $\Delta R > 10\%$ after 1000hrs stress @250C.

8.2.3 46nm Process: 300 mm FAB

1. TDDDB

(years)								Pass/ Fail
	Ntn	Ntk	Ptn	Ptk	Array	STC- Plate+	STC- Node+	
1 st Qual.	3.40E+03	1.16E+01	6.16E+03	1.21E+03	4.01E+01	7.84E+04	3.98E+01	Pass
2 nd Qual.	1.83E+03	1.51E+01	9.15E+03	1.11E+02	6.28E+01	8.51E+03	8.21E+01	Pass
3 rd Qual.	2.30E+04	1.37E+01	5.34E+03	3.57E+02	1.25E+02	8.45E+02	3.59E+01	Pass

2. HCE:

AC(years)	NFET	NFET	Pass/ Fail
	nf	nflo	
	L=0.065	L=0.08	
1 st Qual.	3.37E+09	3.19E+07	Pass
2 nd Qual.	1.77E+10	2.30E+07	Pass
3 rd Qual.	3.46E+09	9.29E+08	Pass

AC(years)	NFET			NFET			Pass/ Fail
	nflotk	nflotk	nflotk	nftk	nftk	nftk	
	L=0.14	L=0.21	L=0.3	L=0.125	L=0.21	L=0.30	
1 st Qual.	8.76E+01	3.54E+01	3.06E+01	3.32E+01	1.25E+01	1.35E+01	Pass
2 nd Qual.	9.85E+01	3.88E+01	1.71E+01	3.39E+01	1.71E+01	1.44E+01	Pass
3 rd Qual.	5.33E+01	5.44E+01	4.54E+01	6.51E+01	2.11E+01	1.49E+01	Pass

(years)	PFET	PFET	Pass/ Fail
	pf	pflo	
	L=0.065	L=0.08	
1 st Qual.	1.04E+10	2.20E+10	Pass
2 nd Qual.	3.06E+09	3.19E+10	Pass
3 rd Qual.	8.72E+09	4.47E+08	Pass

(years)	PFET		PFET		Pass/ Fail
	pflotk	pflotk	pftk	pftk	
	L=0.14	L=0.18	L=0.125	L=0.18	
1 st Qual.	1.73E+03	6.78E+03	6.67E+04	4.96E+04	Pass
2 nd Qual.	5.44E+03	1.57E+05	4.27E+05	1.84E+04	Pass
3 rd Qual.	4.33E+03	3.91E+04	8.29E+04	1.20E+03	Pass

3. BT:

DC(years)	Pf	Pftk	Pass/ Fail
	L=0.065	L=0.125	
1 st Qual.	2.20E+01	6.54E+02	Pass
2 nd Qual.	1.32E+01	4.10E+02	Pass
3 rd Qual.	5.49E+01	7.35E+01	Pass

4. EM: E=0.85 n=1.7

Lot	Structure	Stress	Condition	Lifetime	Pass / Fail
		T (C)	Current (mA)	(Hours)	
Lot#1	C1us_0.092_M1	235	1.38	1.09E+04	Pass
	C1us_210_ML	235	12.936	1.33E+03	Pass
	C1us_110_C1	235	0.786	9.37E+03	Pass
	C1us_500_CL	235	0.912	2.95E+03	Pass
Lot#2	C1us_0.092_M1	235	1.38	2.58E+04	Pass
	C1us_210_ML	235	12.936	1.26E+03	Pass
	C1us_110_C1	235	0.786	5.66E+03	Pass
	C1us_500_CL	235	0.912	5.10E+03	Pass
Lot#3	C1us_0.092_M1	235	1.38	3.30E+04	Pass
	C1us_210_ML	235	12.936	1.29E+03	Pass
	C1us_110_C1	235	0.786	8.37E+03	Pass
	C1us_500_CL	235	0.912	6.10E+03	Pass

5. SM: Pass. There is no samples with $\Delta R > 10\%$ after 1000hrs stress @250C.