Reliability Qualification Report

for

LPDDR4X SDRAM with Pb/Halogen Free (Industrial)

(8Gb ,512M×16,AS4C512M16MD4VA-046BIN)

2. General Information

Part Number	Density / Operating Condition				PKG	Qualification
	Density Org.	Max. Clock Freq.	Temperature	Voltage		
AS4C512M16MD4 VA-046BIN	**8Gb X16**	**2133MHZ**	**-40℃ to +85℃**	**VDD1=1.8V, VDD2=1.1V, VDDQ=0.6V**	**200ball FBGA**	**Qualified**

3. Accelerated Test Results

-. Life Test Results for 8Gb LPDDR4x SDRAM

Reliability item	Ref	Condition	Samples	Test Results (No. of Fail)			
				48 hrs	168 hrs	504 hrs	1008 hrs
EFR (Early Life Failure Rate)	**AEC Q100-008 JESD22-A108**	**Dynamic Stress Ta=125℃**	**2,000**	**0**	**-**	**-**	**-**
HTOL (High Temperature Operating Life)	**JESD22-A108**	**Dynamic Stress Ta=125℃**	**387**	**-**	**0**	**0**	**0**
MTTF of EFR and HTOL				**338.6 ppm**	**57.07FIT**	**19.02FIT**	**9.51FIT**
LTOL (Low Temperature Operating Life)	**JESD22-A108**	**Dynamic Stress Ta=125℃**	**387**	**-**	**0**	**0**	**0**

AFv=exp{β*(Vstress-Vuse)}

- AFv : Voltage acceleration factor
- Vuse : Internal voltage at normal use
- Vstress : Internal voltage at EFR, HTOL
- β : Constant (dependent upon electric field constant, oxide thickness, etc)
  β = 8/V. And then **EFR & HTOL AFv=11.02**

AFt=exp{Ea/K*(1/Ta_use -1/Ta_stress)}

- At : Temperature acceleration factor
- Ea : Activation energy
- Ta_use : Ambient temperature (in K) at Ta=55 ºC (Temperature at normal use)
- Ta_stress : Ambient temperature (in K) (Temperature at EFR, HTOL)
- K : Boltzman's constant=8.623×10^{-5} eV/K

Tuse = 55℃, Tstress = 125℃, Ea=0.5V, And then **EFR & HTOL AFt=22.40**

AF=Afv * Aft =11.02 * 22.40 = 246.96

4. Electrical Verification Test Results

-. ESD and Latch up for 8Gb LPDDR4x SDRAM

Reliability item	Test Standard	Condition	Sample	Criteria	Test Results
Electro Static Discharge	AEC Q100-002 MIL-STD-883	HBM	3 per condition	1,000V	Pass (> 1,500V)
	JESD22-A115B	MM	3 per condition	200V	Pass (> 500V)
Latch-Up	AEC Q100-004 JESD78	Vcc Test @85℃	3 per condition	≥ 1.5xVcc.max	Pass (>2.93V)
		I Test @ 85℃	3 per condition	≥ ±150mA	Pass (>150mA)

5. Environmental Stress Test Results

Reliability item	Ref.	Condition	Sample	Test Results (No. of Fail)		
PC (Preconditioning, MSL3)	J-STD-020 JESD22-A113	Temp. cycle(-50℃/150℃, 5cycle)+Baking 125℃/24Hrs +Soak (30℃/60%RH,192hrs) +IR Reflow(250℃, 3 times)	270	0		
				168hrs	504hrs	1008hrs
HTSL (High Temperature Storage Life Test)	JESD22-A103	Ta=150℃	135	0	0	0
				48hrs	96hrs	
Biased HAST* (Highly Accelerated Temperature and Humidity Stress Test)	JESD22-A110	Ta=130℃, R.H=85%, VDD = 1.9 5 V, VBB= 0.65 V, VCC = 1.17 V, VREF= 1.17 V	135	0	0	
				200cyc	500cyc	1000cyc
TC* (Temperature Cycle)	JESD22-A104	-25℃/+125℃ air to air	135	0	0	0

❖ PC performed before HAST and TC stresses.

6. Fab. Process Reliability Test Results

Item	Sample Size	Test Condition	Test Results (0.1% Fail Time)	Failure Criteria
TDDB	3Wafer / 3Lot	Bias : 5.6V / 5.8V / 6.0V Temp. : 125℃	> 10years	F(100Khr) < 0.01% Fail
Hot Carrier	3Wafer / 3Lot	Vg : Vg at max Isub Vd : 3.7V / 3.9V / 4.1V	> 10years	F(100Khr) < 0.1% Fail (ΔIDSat > 10%)
NBTI	3Wafer / 3Lot	Bias : 2.1V/1.9V/1.7V Temp. : 125℃	> 10years	F(100Khr) < 0.1% Fail (ΔIDSat > 10%)
E/M	3Wafer / 3Lot	Current Density : 2~7 MA/Cm2 Temp. : 200~300℃	> 10years	F(100Khr) < 0.1% Fail (ΔR > 10%)
S/M	3Wafer / 3Lot	Temp. : 250℃	> 10years	F(100Khr) < 0.1% Fail (ΔR > 5%)

7. Soft Error Rate for DRAM

-. High Energy Neutron Test for 8Gb LP DDR4x

Test Site	TRIUMF@CANADA					
Beam type	Neutron					
Sample Size	4 pcs					
Overall Test Results	SBU	MBU	SEL	SEFI		
				Row	Col	Total
FIT / Gbit	0	0	0	0.031	0.265	0.296

- **The overall cosmic-ray FIT at sea level in NYC**
- **FIT/Chip = FIT/Gbit * Chip Density[Gbit]**

*** SBU(Single Bit Upset), MBU(Multiple Bit Upset), SEL(Single Event Latch-up), SEFI(Sing le Event Functional Interrupt)**