MACRONIX
INTERNATIONAL CO., LTD.

Quality & Reliability Quarterly Report

Q3, 2022

MACRONIX INTERNATIONAL CO., LTD.

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1. Quality/Reliability Monitoring Test Items and Conditions:

Test Item	Test Method	Test Conditions	Typical Sample Size (units)
Quality Validation (QV)	JESD86A	DC/AC tests for full range temperature, Vcc/Vpp, refer to datasheet	All samples
Early Life Failure Rate (ELFR)	JESD22-A108F and JESD74A	125°C, Vcc(max), 48 hrs	2000
Non-Volatile Memory Cycling Endurance (NVCE)	JESD47K JESD22-A117E AEC-Q100-005D (For Automotive Product)	Half samples at 25 °C, half samples at max operating Temperature, 1K/10K/100K Program/Erase cycles. (NAND: 10%/100% cycles of max endurance specification.)	77 Automotive Product: Sum of sample size for HTDR, LTDR, and HTOL
Nonvolatile Memory Low-Temperature Data Retention and Read Disturb (LTDDR)	JESD47K JESD22-A117E AEC-Q100-005D (For Automotive Product)	25 °C, Vcc(max), cycles per NVCE (≥25 °C), 168hrs/500hrs. 1000hrs for automotive only.	38 Automotive Product:38
Nonvolatile Memory Post-cycling High Temperature Data Retention (PCHTDR)	JESD47K JESD22-A117E AEC-Q100-005D (For Automotive Product)	125°C, cycles per NVCE (≥55 °C), 10hrs/100hrs. (at 10 hours if cycles to max spec, at 100 hours if cycles ≤10% max. spec) (NAND SLC at 100 hours if cycles ≤1% max. spec).	39 Automotive Product: 38
High Temperature Operating Life (HTOL)	JESD22-A108F and JESD85 AEC-Q100-005D (For Automotive Product)	125°C, Vcc(max), 168hrs/500hrs/1000hrs	77 Automotive Product:77
High Temperature Storage Life (HTSL)	JESD22-A103E	150°C, 168hrs/500hrs/1000hrs	77
Preconditioning (PC) SMD only	JESD22-A113I	Refer to OI# 5650-0901(must be done before HAST/AC/TC for SMDs)	All the SMD qual samples for package tests
Temperature Cycling (TC)	JESD22-A104F condition C	-65°C to 150°C, 200/500 cycles	77
Highly-Accelerated Temperature and Humidity Stress (HAST)	JESD22-A110E	130°C, 85% RH,Vcc(max), 96hrs	77
Autoclave (AC) or Unbiased HAST (UHAST)	JESD22-A102E JESD22-A118B	121°C /100%RH, 96 hrs or 130°C / 85%RH, 96 hrs	77

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2. Flash Quarterly Reliability Monitor Results:

2-1. Quality Validation & Early Life Failure Rate :

Tech.	EPN Code	QV		ELFR	
		SS	Reject	SS	Reject
0.15 µm	MX29LV400C	4000	0	2000	0
0.13 µm	MX29LV160D	4000	0	2000	0
0.11 µm	MX25L6445E	4000	0	2000	0
	MX25L3206E	2000	0	*1	*1
	MX25U1635E	2000	0	*1	*1
	MX25L6445E	1200	0	*2	*2
	MX25L3235E	1200	0	*2	*2
	MX25U3235E	600	0	*2	*2
75 nm	MX25L12833F	2000	0	*1	*1
	MX25L12835F	2000	0	2000	0
	MX25R8035F	2000	0	*1	*1
	MX25U12832F	4000	0	2000	0
	MX25S6433F	12000	0	2000	0
	MX25L12833F	600	0	*2	*2
	MX25L3233F	1200	0	*2	*2
	MX25U6435F	1200	0	*2	*2
	MX25U12832F	1200	0	*2	*2
68 nm	MX25V16066M	4000	0	2000	0
	MX25V64366M	*1	*1	*1	*1
55 nm	MX25L25645G	4000	0	2000	0
	MX25U51245G	2000	0	*1	*1
	MX25L25645G	600	0	*2	*2
	MX25U51245G	1200	0	*2	*2
36 nm	MX30LF1G18AC	2000	0	2000	0
	MX30LF4G18AC	1200	0	*2	*2
19 nm	MX30LMBGX8AA	4000	0	2000	0
	MX30LF2G28AD	6000	0	4000	0
	MX30UF4G28AD	8000	0	8000	0

*1: Means the test is “on going”. The results will be updated next quarter.

*2 : No ELFR test, the samples are only used for QV and NVCE test.

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2-2. Non-Volatile Memory Cycling Endurance:

Tech.	EPN Code	NVCE@25°C		NVCE@85°C	
		SS	Reject	SS	Reject
0.15 µm	MX29LV400C	308	0	154	0
0.13 µm	MX29LV160D	76	0	78	0
0.11 µm	MX25L6445E	76	0	78	0
	MX25L3206E	38	0	39	0
	MX25U1635E	*1	*1	*1	*1
75 nm	MX25L12833F	*1	*1	*1	*1
	MX25L12835F	38	0	39	0
	MX25R8035F	38	0	*1	*1
	MX25U12832F	38	0	39	0
	MX25S6433F	114	0	117	0
68 nm	MX25V16066M	38	0	78	0
	MX25V64366M	*1	*1	*1	*1
55 nm	MX25L25645G	76	0	39	0
	MX25U51245G	38	0	39	0
36 nm	MX30LF1G18AC	38	0	39	0
19 nm	MX30LMBGX8AA	38	0	39	0
	MX30LF2G28AD	114	0	117	0
	MX30UF4G28AD	152	0	156	0

*1: Means the test is "on going". The results will be updated next quarter.

2-3. Data Retention:

Tech.	EPN Code	LTDDR@25°C 500hrs		PCHTDR@125°C 100hrs	
		SS	Reject	SS	Reject
0.13 µm	MX29LV160D	38	0	78	0
0.11 µm	MX25L6445E	38	0	39	0
	MX25L3206E	*1	*1	39	0
	MX25U1635E	*1	*1	*1	*1
75 nm	MX25L12833F	*1	*1	*1	*1
	MX25L12835F	38	0	39	0
	MX25R8035F	*1	*1	*1	*1
	MX25U12832F	38	0	39	0
	MX25S6433F	38	0	39	0
68 nm	MX25V16066M	*1	*1	*1	*1
	MX25V64366M	*1	*1	*1	*1
55 nm	MX25L25645G	38	0	39	0
	MX25U51245G	*1	*1	39	0
36 nm	MX30LF1G18AC	*1	*1	39	0

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Tech.	EPN Code	SS	Reject	SS	Reject
19 nm	MX30LMBGX8AA	38	0	39	0
	MX30LF2G28AD	76	0	78	0
	MX30UF4G28AD	114	0	156	0

*1: Means the test is "on going". The results will be updated next quarter.

2-4. Non-Volatile Memory Program/ Erase Endurance, Data Retention and Operation Life (For Automotive Product)

a. High Temperature

Tech.	EPN Code	NVCE@125°C		PCHTDR@150°C 500hrs		HTOL@125°C 1000hrs	
		SS	Reject	SS	Reject	SS	Reject
0.11 µm	MX25L6445E	232	0	39	0	77	0
	MX25L3235E	232	0	39	0	*1	*1
75 nm	MX25L12833F	116	0	*1	*1	*1	*1
	MX25L3233F	232	0	78	0	77	0
	MX25U6435F	232	0	39	0	*1	*1
	MX25U12832F	116	0	39	0	*1	*1
55 nm	MX25L25645G	116	0	*1	*1	*1	*1
	MX25U51245G	232	0	39	0	*1	*1

*1: Means the test is "on going". The results will be updated next quarter.

Tech.	EPN Code	NVCE@105°C		PCHTDR@150°C 500hrs		HTOL@125°C 1000hrs	
		SS	Reject	SS	Reject	SS	Reject
0.11 µm	MX25U3235E	116	0	39	0	*1	*1

*1: Means the test is "on going". The results will be updated next quarter.

Tech.	EPN Code	NVCE@105°C		PCHTDR@150°C 100hrs		HTOL@125°C 1000hrs	
		SS	Reject	SS	Reject	SS	Reject
36 nm	MX30LF4G18AC	116	0	39	0	77	0

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b. Low Temperature

Tech.	EPN Code	NVCE@25°C		LTDDR@25°C 1000hrs	
		SS	Reject	SS	Reject
0.11 µm	MX25L6445E	76	0	38	0
	MX25L3235E	76	0	38	0
	MX25U3235E	38	0	38	0
75 nm	MX25L12833F	38	0	*1	*1
	MX25L3233F	76	0	38	0
	MX25U6435F	76	0	38	0
	MX25U12832F	38	0	*1	*1
55 nm	MX25L25645G	38	0	*1	*1
	MX25U51245G	76	0	38	0
36 nm	MX30LF4G18AC	38	0	38	0

*1: Means the test is “on going”. The results will be updated next quarter.

2-5. High Temperature Operating Life and High Temperature Storage Life:

Tech.	EPN Code	HTOL 1000hrs		HTSL 1000hrs	
		SS	Reject	SS	Reject
0.15 µm	MX29LV400C	77	0	77	0
0.13 µm	MX29LV160D	77	0	154	0
0.11 µm	MX25L6445E	77	0	77	0
	MX25L3206E	*1	*1	77	0
	MX25U1635E	*1	*1	77	0
75 nm	MX25L12833F	77	0	77	0
	MX25L12835F	77	0	77	0
	MX25R8035F	77	0	77	0
	MX25U12832F	77	0	77	0
	MX25S6433F	*1	*1	*1	*1
68 nm	MX25V16066M	154	0	154	0
	MX25V64366M	*1	*1	*1	*1
55 nm	MX25L25645G	77	0	77	0
	MX25U51245G	77	0	77	0
36 nm	MX30LF1G18AC	77	0	77	0
19 nm	MX30LMBGX8AA	77	0	77	0
	MX30LF2G28AD	154	0	154	0
	MX30UF4G28AD	231	0	308	0

*1: Means the test is “on going”. The results will be updated next quarter.

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2-6. Pre-Condition / Autoclave / Temperature Cycling / Highly Accelerated Temperature and Humidity Stress:

Tech.	EPN Code	PC		TC 500cycles		AC 96hrs		HAST 96hrs	
		SS	Reject	SS	Reject	SS	Reject	SS	Reject
0.15 µm	MX29LV400C	462	0	77	0	154	0	77	0
0.13 µm	MX29LV160D	462	0	154	0	154	0	154	0
0.11 µm	MX25L6445E	462	0	77	0	154	0	154	0
	MX25L3206E	231	0	77	0	77	0	77	0
	MX25U1635E	231	0	77	0	77	0	77	0
75 nm	MX25L12833F	231	0	77	0	77	0	77	0
	MX25L12835F	462	0	77	0	154	0	77	0
	MX25R8035F	231	0	77	0	77	0	77	0
	MX25U12832F	462	0	77	0	77	0	77	0
	MX25S6433F	1617	0	462	0	539	0	539	0
68 nm	MX25V16066M	693	0	231	0	231	0	231	0
	MX25V64366M	*1	*1	*1	*1	*1	*1	*1	*1
55 nm	MX25L25645G	462	0	77	0	154	0	77	0
	MX25U51245G	231	0	77	0	77	0	77	0
36 nm	MX30LF1G18AC	231	0	77	0	77	0	77	0
19 nm	MX30LMBGX8AA	231	0	77	0	77	0	77	0
	MX30LF2G28AD	693	0	154	0	231	0	154	0
	MX30UF4G28AD	924	0	231	0	308	0	231	0

*1: Means the test is “on going”. The results will be updated next quarter.

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