PRODUCT / PROCESS CHANGE NOTIFICATION

1. PCN basic data	
1.1 Company	STMicroelectronics International N.V
1.2 PCN No.	ADG/20/12372
1.3 Title of PCN	SPC564xx and SPC64Axx (FA80): Laser Grooving Introduction
1.4 Product Category	see list
1.5 Issue date	2020-10-06

2. PCN Team	
2.1 Contact supplier	
2.1.1 Name	ROBERTSON HEATHER
2.1.2 Phone	+1 8475853058
2.1.3 Email	heather.robertson@st.com
2.2 Change responsibility	
2.2.1 Product Manager	Luca RODESCHINI
2.1.2 Marketing Manager	Matteo MOIOLI
2.1.3 Quality Manager	Alberto MERVIC

3. Change		
3.1 Category	3.2 Type of change	3.3 Manufacturing Location
Methods	Change in separation process from single wafer to die (change from sawing to laser cut, etc..)	ST Muar (Malaysia)

4. Description of change		
	Old	New
4.1 Description	Blade Groowing	Laser Growing
4.2 Anticipated Impact on form,fit, function, quality, reliability or processability?	No impact	

5. Reason / motivation for change	
5.1 Motivation	Quality Improvement
5.2 Customer Benefit	QUALITY IMPROVEMENT

6. Marking of parts / traceability of change	
6.1 Description	Date Code

7. Timing / schedule	
7.1 Date of qualification results	2020-09-30
7.2 Intended start of delivery	2021-01-08
7.3 Qualification sample available?	Not Applicable

8. Qualification / Validation			
8.1 Description	12372 Validation.pdf		
8.2 Qualification report and qualification results	Available (see attachment)	Issue Date	2020-10-06

9. Attachments (additional documentations)

12372 Public product.pdf
12372 Validation.pdf
12372 Details.pdf

10. Affected parts		
10. 1 Current		10.2 New (if applicable)
10.1.1 Customer Part No	10.1.2 Supplier Part No	10.1.2 Supplier Part No
	SPC564A80B4CFAR	

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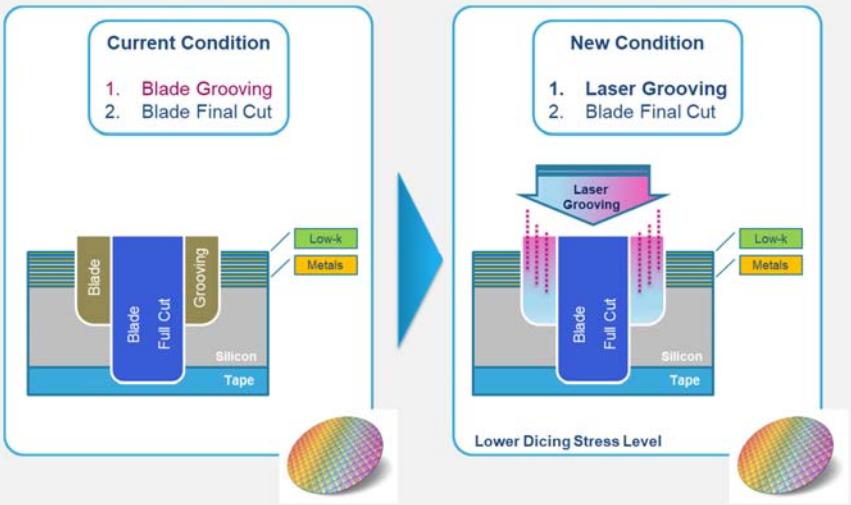
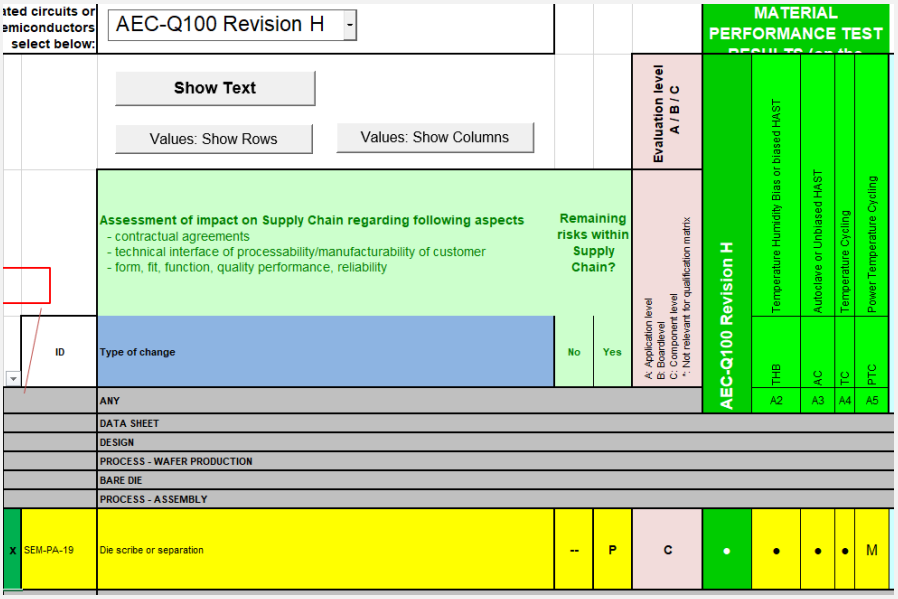
PRODUCT/PROCESS CHANGE NOTIFICATION

SUBJECT	**SPC564xx and SPC64Axx (FA80): Laser Grooving Introduction**
IMPACTED PRODUCTS	ST silicon line FA80 assembled in PBGA23x23x1.82 288+36 package.
MANUFACT. STEP	Assembly – Wafer sawing
INVOLVED PLANT	ST Muar Plant (Malaysia)
CHANGE REASON	Quality Improvement: aimed to eliminate micro-stresses during wafer sawing, reducing possible peeling and/or micro-cracks along sawing street.
CHANGE DESCRIPTION	Current dicing technique is based on two mechanical sawing runs: 1. first cut down to Low-k and metals level (grooving); 2. second cut down to complete silicon thickness (full cut). To reduce mechanical stress on Low-k layers, grooving is performed through laser instead of mechanical blade. Second cut remains through mechanical blade (see below scheme). 

TRACEABILITY	Internal traceability and Date Code
VALIDATION	Validation has been performed through standard validation exercise according to ZVEI (AEC-Q100) recommendations. Following qualification plan has been executed:



PTC: not applicable for this type of device.

CURRENT PRODUCTS	Current process shall be replaced by the new one.
REPORT	12372 validation.pdf

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Public Products List

Publict Products are off the shelf products. They are not dedicated to specific customers, they are available through ST Sales team, or Distributors, and visible on ST.com

PCN Title : SPC564xx and SPC64Axx (FA80): Laser Grooving Introduction

PCN Reference : ADG/20/12372

Subject : Public Products List

Dear Customer,

Please find below the Standard Public Products List impacted by the change.

SPC564A80B4CFAR		

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Reliability Report
Andorra 4M Cut 3.2

General Information	
Product Line	*FA80xx*
Product Description	*Andorra 4M Cut 3.2*
Commercial Product	*SPC564A80xx*
Product Group	*APG*
Product division	*MID*
Silicon process technology	*CMOS M10*

Locations	
Wafer fab location	*Crolles 2*

Final Assessment	
Reliability assessment	*Qualification Passed as per Q100 rev G grade 1 and Customer Requirements*

DOCUMENT HISTORY

Version	Date	Author	Comment
1.0	30/04/2013	M. De Tomasi	First Document release
2.0	28/03/2014	R. Enrici Vaion	Second Document release: CuPd wire qualification of LQFP176 added
2.1	10/07/2014	R. Enrici Vaion	Typo error fixed in page 8 for ELFR quantity in trial
3.0	12/12/2014	R. Enrici Vaion	Third Document release: BGA324 package qualification results added
3.1	23/09/2016	M. De Tomasi	POR fix qualification added
3.2	14/02/2018	M. De Tomasi	POR fix qualification on BGA324 added
3.3	02/07/2018	M. De Tomasi	PMU Bypass fix qualification
3.4	25/02/2020	G. Rota	BGA256 Laser Groove qualification: reliability trials completed

RELEASED DOCUMENT

TABLE OF CONTENTS

1 RELIABILITY EVALUATION OVERVIEW

1.1 Objectives

Aim of this document is to report the reliability trials results of Andorra 4M BGA324 Laser Groove (LG) qualification.

Andorra 4M Cut 3.2 is processed in Crolles FAB using CMOS M10 (90 nm) technology and it is assembled in Malta-ST assy line for LQFP176 package with gold wire and CuPd wires and in Muar assy line for BGA324 package with gold wire.

The M10 (90nm technology) process was qualified in Rousset R8 Fab using three logic test chips and a Flash test chip as test vehicles. Andorra 4M cut 2.0 was qualified in Rousset in Q1 2011.

Considering that Andorra4M is the first M10 product with 6 metal layers and FLS Flash diffused in Crolles, no similarity with other qualified products could be considered.

The qualification exercise was based on 3 cut 3.0 diffusion lots plus 1 cut 3.1 and 1 cut 3.2 diffusion lot coming from Crolles: assy reports required on all qualification lots.

The differences between Andorra 4M cut 3.0, cut 3.1 and cut 3.2 are the minor design fix introduced to:

- improve the robustness of the device during power on phase (cut 3.1)
- improve the robustness of the oscillator during power on phase with internal regulator disabled (cut 3.2)

Only metal mask involved with very limited modifications in routing. Qualification plan compliant to Q100 requirements for fix qualification.

CuPd wire has been introduced on Andorra4M LQFP176 package assembled in Malta, through the following steps:

- Mat10: Bond Pad Validation (feasibility assessment), done on 6M1T process option (test vehicle Andorra 4M LQFP176)
- Mat20: full package qualification on three assembly lots with bonding corner conditions.
- Mat30: package qualification on Andorra4M LQFP176 has been defined considering similarity with Monaco1M5 LQFP144 (diffused in Crolles and assembled in CuPd wire), 2 lots of Andorra 4M LQFP176 and 2 lots of Monaco 1.5M LQFP144 has been used:
  - same complexity from process point of view: both are 6M1T
  - same pad class (identical pad structure under bonding area)
  - same assembly line and Bill of Material
- Production Feasibility: line stressing performed on 30K parts to assess manufacturability (shared between Andorra4M LQFP176 and Monaco1M5 LQFP144)

Andorra4M product assembled in BGA324, Muar assy line, was already qualified with Rousset silicon since 2010. Due to Crolles silicon introduction and BOM changes (glue type, wire diameter and minimum BPO) a full package qualification (3 assy lots) has been performed.

Laser Groove recipe introduced on BGA324 package with Crolles silicon. Qualification has been defined considering similarity with Bolero3M BGA256. 2 lots of Andorra 4M BGA324 and 1 lot of Bolero 3M BGA256 have been used.

The qualification exercise is in respect of AEC-Q100 rev G specification.

1.2 Conclusions

All qualification trials have been completed with positive results on LQFP176 and BGA324 packages. Neither functional nor parametric rejects were detected at final electrical testing.
AEC-Q100 Grade 1 is granted on Andorra 4M assembled in LQFP176 and BGA324 packages.

2 TRACEABILITY

2.1 Wafer fab information

DIE FEATURES	
Diffusion Site	*Crolles 2*
Wafer Diameter (inches)	12
Process Technology	*CMOS M10*
Passivation	PSG - Nit UV
Die finishing back side	Lapped Silicon

2.2 Package outline/Mechanical data

	LQFP 176 (Gold Wire)	LQFP 176 (CuPd Wire)	PBGA 324 (Gold Wire)
Package Description	*LQFP 176 24x24x1.4*	*LQFP 176 24x24x1.4*	*PBGA23x23x1.82*
Assembly Site	*ST KIRKOP – MALTA*	*ST KIRKOP – MALTA*	*ST MUAR - MALAYSIA*
Die Attach material	ABLEBOND 3280T	ABLEBOND 3280T	ABLESTIK 2100A
Molding compound	SUMITOMO EME-G700LS	SUMITOMO EME-G700LS	HITACHI GE-100LF1-2
Substrate/Leadframe	LQFP 176L 24SQ RgAg	LQFP 176L 24SQ RgAg	BASE PBGA 324L 23x23 4L
Wires bonding materials/diameters	WIRE Au 2N GPG2 D0.9	CuPd CLR3 D0.7	WIRE Au 2N GPG2 D0.8

2.3 Final testing information:

PACKAGE FEATURES		
Electrical Testing manufacturing location	**:**	ST KIRKOP – MALTA
Tester	**:**	Teradyne J750

3 RELIABILITY PLAN AND TESTS RESULTS CUT 3.0

3.1 Conditions

Room test temperature is 25°C
Hot test temperature is 150°C
Cold test temperature is -40°C

3.2 Tables entry legend

Symbol	How to read
☐	Action or condition has not to be considered
☒	The action/condition has been done/applied during the trial
N.P.N.P.	The trial or readout is not in the Qualification Plan and thus has not been performed

3.3 Accelerated Environmental Stress Test (Q100 Group A)

Test			Step	Results			Notes
N	TEST NAME	CONDITIONS [SPEC]		LQFP176 (Gold wire)	LQFP176 (CuPd wire)	BGA324 (Gold wire)	
1	**Pre Conditioning MSL 3**	[J-STD-020] ☒ Testing at Room ☒ Testing at Hot ☒ Testing at Cold* ☒ Sonoscan pre / post ☒ 100 Temperature Cycles 24h bake@125°C, 192h@30°C/60%RH 3x Reflow simulation 260°C Peak Temp	**Pre**	0/231 x 3	0/231 Lot1 0/904 Lot2 0/981 Lot3 Andorra4M 0/231 Lot1 0/904 Lot2 0/981 Lot3 Monaco1M5 LQFP144	0/231 x 3	LQFP176: Similarities with Monaco1M5 LQFP144 for CuPd qualification *done only for CuPd qualification
			Post	0/231 x 3	0/231 Lot1 0/904 Lot2 0/981 Lot3 Andorra4M 0/231 Lot1 0/904 Lot2 0/981 Lot3 Monaco1M5 LQFP144	0/231 x 3	
2	**THB** Temperature Humidity Bias	[JESD22-A101/A110] ☒ AfterJedec PC MSL3 ☒ Testing at Room ☒ Testing at Hot ☐ Testing at Cold ☒ WPT pre / post (first and second bond) * ☒ WBS pre / post * ☒ Visual Inspection * ☒ Cross section * ☒ Drift Analysis * Ta=85°C, 85%RH, 1000hrs (3000hrs monitoring)*	**1000 hrs**	0/77 x 3	0/77 x 2 Andorra4M 0/77 x 1 Monaco1M5 LQFP144	0/77 x 3	LQFP176: Similarities with Monaco1M5 LQFP144 for CuPd qualifcation *done only for CuPd qualification

3	**THS** Temperature Humidity Storage	[JESD22-A101/A110] ☒ AfterJedec PC MSL3 ☒ Testing at Room ☒ Testing at Hot ☐ Testing at Cold ☒ WPT pre / post (first and second bond) * ☒ WBS pre / post * ☒ Visual Inspection * ☒ Cross section * ☒ Drift Analysis * Ta=85°C, 85%RH, 1000hrs (3000hrs monitoring)*	**1000 hrs**	N.P.	0/77 x 1 Andorra4M 0/77 x 2 Monaco1M5 LQFP144	0/77 x 3	LQFP176: Similarities with Monaco1M5 LQFP144 for CuPd qualifcation *done only for CuPd qualification
4	**AC** Autoclave	[JESD22-A102/A118] ☒ AfterJedec PC MSL3 ☒ Testing at Room ☐ Testing at Hot ☐ Testing at Cold ☒ WPT pre / post (first and second bond) * ☒ WBS pre / post * ☒ Visual Inspection * ☒ Cross section * ☒ Drift Analysis * P=2.08atm Ta=121°C, 96hrs	**96 hrs**	0/77 x 3	0/77 x 2 Andorra4M 0/77 x 2 Monaco1M5 LQFP144	N.P.	LQFP176: Similarities with Monaco1M5 LQFP144 for CuPd qualifcation *done only for CuPd qualification
5	**TC** Temperature Cycling	[JESD22-A104] ☒ AfterJedec PC MSL3 ☒ Testing at Room ☒ Testing at Hot ☒ Testing at Cold* ☒ Sonoscan pre / post ☒ WPT pre / post (first and second bond) ☒ WBS pre / post * ☒ Visual Inspection * ☒ Cross section * ☒ Cratering test pre/post * ☒ Drift Analysis * Ta=-50°C /+150 °C 1000 cyc (3000cyc monitoring)*	**1000 cyc**	0/77 x 3	0/77 x 2 Andorra4M 0/77 x 2 Monaco1M5 LQFP144	0/77 x 3	LQFP176: Similarities with Monaco1M5 LQFP144 for CuPd qualifcation *done only for CuPd qualification
6	**PTC** Power Temperature Cycle	[JESD22-A105] ☐ After Jedec PC MSL3 ☐ Testing at Room ☐ Testing at Hot ☐ Testing at Cold Ta=-40°C /+125 °C 1000 cyc	**1000 cyc**	N.P.	N.P.	N.P.	**Not required on Andorra 4M**

7	**HTSL** High Temperature Storage Lifetime	[JESD22-A103] ☒ AfterJedec PC MSL3 ☒ Testing at Room ☒ Testing at Hot ☐ Testing at Cold ☐ Sonoscan pre / post ☒ WPT pre / post (first and second bond) ☒ WBS pre / post * ☒ Cross section * ☒ Drift Analysis * Ta= 175ºC 336hrs* (500hrs monitoring)* Ta= 150ºC 1000hrs (3000hrs monitoring)*	**336 hrs** Ta=175ºC	N.P.	0/77 x 1 Andorra4M 0/77 x 1 Monaco1M5 LQFP144	N.P.	LQFP176: Similarities with Monaco1M5 LQFP144 for CuPd qualifcation *done only for CuPd qualification
			1000hrs Ta=150ºC	See HTDR trial	0/77 x 2 Andorra4M 0/77 x 2 Monaco1M5 LQFP144	0/77 x 3	
8	**uHAST** Unbiased Accelerated Stress Test	[JESD22-A118] ☒ AfterJedec PC MSL3 ☒ Testing at Room ☒ Testing at Hot ☐ Testing at Cold ☒ WPT pre / post (first and second bond) * ☒ WBS pre / post * ☒ Visual Inspection * ☒ Cross section * ☒ Drift Analysis * Ta=130°C, 85%RH, 96hrs	**96 hrs**	N.P.	0/750 x 2 Andorra4M 0/750 x 2 Monaco1M5 LQFP144	N.P.	LQFP176: Similarities with Monaco1M5 LQFP144 for CuPd qualifcation *done only for CuPd qualification

3.4 Accelerated Lifetime Simulation Test (Q100 Group B)

Test			Step	Results			Notes
N	TEST NAME	CONDITIONS [SPEC]		Lot 1	Lot 2	Lot 3	
1	**HTOL** High Temp. Operating Life	[JESD22-A108] ☒ After Jedec PC MSL3 ☒ After 1k W/E cyc @125°C ☒ Testing at Room, Hot, Cold ☒ Drift Analysis on Key parameters at Room, Hot, Cold Ta=125ºC, Tj=150°C VDD+20% 1000hrs	**1000 hrs**	0/77	0/77	0/77	
2	**ELFR** Early Life Failure Rate	[AEC Q100-008] ☒ Testing at Room, Hot, Cold Ta= 125ºC, Tj=150°C, BI+24hrs	**BI+24hrs**	0/800	0/800	0/800	
3	**HTDR** High Temp. Data Retention	[AEC Q100-005] ☒ After Jedec PC MSL3 ☒ Testing at Room ☒ Testing at Hot ☐ Testing at Cold ☒ After 1k W/E cyc @125°C ☒ Vth Drift Analysis Ta= 150ºC, All0 Pattern 2000hrs	**2000 hrs**	0/77	0/77	0/77	
4.a	**FET @25°C**	[AEC Q100-005] ☒ Drift Analysis on Flash key parameters at Room, Hot, Cold Ta= 25ºC 100k Write/Erase cyc	**100k cyc**	0/77	N.P.	N.P.	
4.b	**HTDR After FET**	☒ Vth Drift Analysis Ta= 150ºC, All0 Pattern 168hrs	**168 hrs**	0/77	N.P.	N.P.	
5.a	**FET @125°C**	[AEC Q100-005] ☒ Drift Analysis on Flash key parameters at Room, Hot, Cold Ta= 125ºC 100k Write/Erase cyc	**100k cyc**	0/77	0/77	0/77	
5.b	**HTDR After FET**	☒ Vth Drift Analysis Ta= 150ºC, All0 Pattern 168hrs	**168 hrs**	0/77	0/77	0/77	

6.a	**FET @-40°C**	[AEC Q100-005] ☒ Drift Analysis on Flash key parameters at Room, Hot, Cold Ta= -40ºC 100k Write/Erase cyc	**100k cyc**	N.P.	0/77	N.P.	
6.b	**HTDR After FET**	☒ Vth Drift Analysis Ta= 150ºC, All0 Pattern 168hrs	**168 hrs**	N.P.	0/77	N.P.	
7	**LTDR** Low Temp. Data Retention	[AEC Q100-005] ☒ Vth Drift Analysis After 1k W/E cyc @25°C Ta= 60ºC, All0 Pattern 2000hrs	**2000 hrs**	0/77	N.P.	N.P.	
8	**LTDR** Low Temp. Data Retention	[AEC Q100-005] ☒ Vth Drift Analysis After 10k W/E cyc @25°C Ta= 60ºC, All0 Pattern 2000hrs	**2000 hrs**	0/77	N.P.	N.P.	
9	**LTDR** Low Temp. Data Retention	[AEC Q100-005] ☒ Vth Drift Analysis After 100k W/E cyc @25°C Ta= 60ºC, All0 Pattern 2000hrs	**2000 hrs**	0/77	N.P.	N.P.	
10	**Flip Bit**	[AEC Q100-005] ☒ Vth Drift Analysis After 1 W/E cyc @25°C Ta= 25ºC, Chk Pattern 1000hrs	**1000 hrs**	N.P.	0/77	N.P.	
11	**Read Disturb**	After 10 W/E cyc @25°C Ta= 25ºC; 4,5V Stress <1ppm after 6000hrs with ECC	**Final**	N.P.	0/77	N.P.	
12	**Read Disturb**	After 10k W/E cyc @25°C Ta= 25ºC; 4,5V Stress <1ppm after 1 sec with ECC	**Final**	N.P.	N.P.	0/77	

3.5 Package Assembly Integrity Test (Q100 Group C)

Test			Step	Results			Notes
N	TEST NAME	CONDITIONS [SPEC]		LQFP176 (Gold wire)	LQFP176 (CuPd wire)	BGA324 (Gold wire)	
1	**WBS** Wire Bond Shear	[AEC Q100-001] At appropriate time interval for each bonder to be used 30 bonds x 5 devices	**Final result**	Done	Done	Done	
2	**WBP** Wire Bond Pull	[MIL-STD883 method 2011] 30 bonds x 5 devices	**Final result**	Done	Done	Done	
3	**SD** Solderability	[JEDEC JEDES22-B102] > 95% lead coverage	**Final result**	Done	Done	Done	Assy report
4	**PD** Physical Dimension	[JEDEC JEDES22-B100 and B108]	**Final result**	Done	Done	Done	Assy report
5	**SBS** Solder Ball Shear	[AEC Q100-010]	**Final result**	N.A.	N.A.	Done	Not applicable for LQFP package
6	**LI** Lead Integrity	[JEDEC JEDES22-B105]	**Final result**	N.A.	N.A.	N.A.	Not applicable

3.6 Die Fabrication Reliability Test (Q100 Group D)

Test			Step	RESULTS	Notes
N	TEST NAME	CONDITIONS			
1	**EM** Electromigration	The data, test method, calculation and internal criteria should be available to the customer upon request for new technologies	**Final result**	DONE	Process qualification
2	**TDDB** Time Dependent Dielectric Breakdown	The data, test method, calculation and internal criteria should be available to the customer upon request for new technologies	**Final result**	DONE	Process qualification
3	**HCI** Hot Carrier Injection	The data, test method, calculation and internal criteria should be available to the customer upon request for new technologies	**Final result**	DONE	Process qualification
4	**NBTI** Negative Bias Temperature Instability	The data, test method, calculation and internal criteria should be available to the customer upon request for new technologies	**Final result**	DONE	Process qualification
5	**SM** Stress Migration	The data, test method, calculation and internal criteria should be available to the customer upon request for new technologies	**Final result**	DONE	Process qualification

3.7 Electrical Verification Test (Q100 Group E)

Test			Step	RESULTS			Notes
N	TEST NAME	CONDITIONS [AEC Q100]		LQFP176 (Gold wire)	LQFP176 (CuPd wire)	BGA324 (Gold wire)	
1.a	**ESD HBM**	HBM = 2kV	**Final result**	**PASSED**		**PASSED**	
1.b	**ESD MM**	MM = 200V	**Final result**	**PASSED**		**PASSED**	
1.c	**ESD CDM**	CDM = 500V / 750V corner only	**Final result**	**PASSED**		**PASSED**	
2.a	**LU**	Class II - Level A (+/- 100mA)	**Final result**	**PASSED**		**PASSED**	
2.b	**LU**	Class II - Level A (1,5 x Vmax)	**Final result**	**PASSED**		**PASSED**	
3	**ED** Electrical Distribution	[AEC Q100-009] ☒ Testing at Room ☒ Testing at Hot ☒ Testing at Cold	**Final result**	DONE	DONE	DONE	
4	**FG** Fault Grading	[AEC Q100-007] FG shall be = or > 90% for qual units	**Final result**	DONE by Similarity			Andorra 4M Cut 2.0
5	**CHAR** Characterization	[AEC Q103] Performed on new technologies and part families. ☒ Testing at Room ☒ Testing at Hot ☒ Testing at Cold	**Final result**	DONE			
6	**GL** Electrothermally -Induced Gate Leakage	[AEC Q100-006] Test before and after GL at room temperature within 96hours of GL stress completion	**Final result**	DONE			
7	**EMC** Electromagnetic Compatibility	[SAE J1752/3 – radiated Emission]	**Final result**	N.P.			Not required by Q100
8	**SC** Short Circuit Characterization	[AEC Q100-012] Applicable to all smart power devices. This test and statistical evaluation shall be performed per agreement between user and supplier on a case-by-case basis.	**Final result**	N.A.			Not applicable to Microcontroller
9	**SER** Soft Error Rate	[JEDEC Un-accelerated: JESD89-1 or Accelerated: JESD89-2 & JESD89-3] Applicable to devices with memory sizes 1Mbit SRAM or DRAM based cells. Either test option (un-accelerated or accelerated) can be performed, in accordance to the referenced specifications. This test and its accept criteria is performed	**Final result**	DONE			

3.8 Defect Screening Test (Q100 Group F)

Test			Step	RESULTS	Notes
N	TEST NAME	CONDITIONS			
1	**PAT** Process Average testing	[AEC Q101]	**Final result**	IMPLEMENTED	
2	**SBA** Statistical Bin/Yield Analysis	[AEC Q102]	**Final result**	IMPLEMENTED	

4 RELIABILITY PLAN AND TESTS RESULTS CUT 3.1

4.1 Conditions

Room test temperature is 25°C
Hot test temperature is 150°C
Cold test temperature is -40°C

4.2 Tables entry legend

Symbol	How to read
☐	Action or condition has not to be considered
☒	The action/condition has been done/applied during the trial
N.P.N.P.	The trial or readout is not in the Qualification Plan and thus has not been performed

4.3 Accelerated Environmental Stress Test (Q100 Group A)

Test			Step	Results			Notes
N	TEST NAME	CONDITIONS [SPEC]		LQFP176 (Gold wire)	LQFP176 (CuPd wire)	BGA324 (Gold wire)	
1	**Pre Conditioning MSL 3**	[J-STD-020] ☒ Testing at Room ☒ Testing at Hot ☒ Testing at Cold* ☒ Sonoscan pre / post ☒ 100 Temperature Cycles 24h bake@125°C, 192h@30°C/60%RH 3x Reflow simulation 260°C Peak Temp	**Post**	0/231 Andorra 4M cut 3.0	0/231 Lot1 0/904 Lot2 0/981 Lot3 Andorra4M cut 3.0 0/231 Lot1 0/904 Lot2 0/981 Lot3 Monaco1M5	0/231 Andorra 4M cut 3.0	LQFP176: Similarities with Andorra 4M cut 3,0 and Monaco1M5 LQFP144 for CuPd qualification *done only for CuPd qualification
2	**THB** Temperature Humidity Bias	[JESD22-A101/A110] ☒ AfterJedec PC MSL3 ☒ Testing at Room ☒ Testing at Hot ☐ Testing at Cold ☒ WPT pre / post (first and second bond) * ☒ WBS pre / post * ☒ Visual Inspection * ☒ Cross section * ☒ Drift Analysis * Ta=85°C, 85%RH, 1000hrs (3000hrs monitoring)*1000hrs (3000hrs monitoring)*	**1000 hrs**	0/77 x 3 Andorra 4M cut 3.0	0/77 x 2 Andorra4M cut 3.0 0/77 x 1 Monco1M5	0/77 x 3 Andorra 4M cut 3.0	LQFP176: Similarities with Andorra 4M cut 3,0 and Monaco1M5 LQFP144 for CuPd qualification *done only for CuPd qualification

3	**THS** Temperature Humidity Storage	[JESD22-A101/A110] ☒ AfterJedec PC MSL3 ☒ Testing at Room ☒ Testing at Hot ☐ Testing at Cold ☒ WPT pre / post (first and second bond) * ☒ WBS pre / post * ☒ Visual Inspection * ☒ Cross section * ☒ Drift Analysis * Ta=85°C, 85%RH, 1000hrs (3000hrs monitoring)*	**1000 hrs**	N.P.	0/77 x 1 Andorra4M cut 3.0 0/77 x 2 Monco1M5	0/77 x 3 Andorra 4M cut 3.0	LQFP176: Similarities with Andorra 4M cut 3,0 and Monaco1M5 LQFP144 for CuPd qualification *done only for CuPd qualification
4	**AC** Autoclave	[JESD22-A102/A118] ☒ AfterJedec PC MSL3 ☒ Testing at Room ☐ Testing at Hot ☐ Testing at Cold ☒ WPT pre / post (first and second bond) * ☒ WBS pre / post * ☒ Visual Inspection * ☒ Cross section * ☒ Drift Analysis * P=2.08atm Ta=121°C, 96hrs	**96 hrs**	0/77 x 3 Andorra 4M cut 3.0	0/77 x 2 Andorra4M cut 3.0 0/77 x 2 Monco1M5	N.P.	LQFP176: Similarities with Andorra 4M cut 3,0 and Monaco1M5 LQFP144 for CuPd qualification *done only for CuPd qualification
5	**TC** Temperature Cycling	[JESD22-A104] ☒ AfterJedec PC MSL3 ☒ Testing at Room ☒ Testing at Hot ☒ Testing at Cold* ☒ Sonoscan pre / post ☒ WPT pre / post (first and second bond) ☒ WBS pre / post * ☒ Visual Inspection * ☒ Cross section * ☒ Cratering test pre/post * ☒ Drift Analysis * Ta=-50°C /+150 °C 1000 cyc (3000cyc monitoring)*	**1000 cyc**	0/77 x 3 Andorra 4M cut 3.0	0/77 x 3 Andorra 4M cut 3.0	0/77 x 3 Andorra 4M cut 3.0	LQFP176: Similarities with Andorra 4M cut 3,0 and Monaco1M5 LQFP144 for CuPd qualification *done only for CuPd qualification
6	**PTC** Power Temperature Cycle	[JESD22-A105] ☐ After Jedec PC MSL3 ☐ Testing at Room ☐ Testing at Hot ☐ Testing at Cold Ta=-40°C /+125 °C 1000 cyc	**1000 cyc**	N.P.	N.P.	N.P.	**Not required on Andorra 4M**

7	**HTSL** High Temperature Storage Lifetime	[JESD22-A103] ☒ AfterJedec PC MSL3 ☒ Testing at Room ☒ Testing at Hot ☐ Testing at Cold ☐ Sonoscan pre / post ☒ WPT pre / post (first and second bond) ☒ WBS pre / post * ☒ Cross section * ☒ Drift Analysis * Ta= 175ºC 336hrs* (500hrs monitoring)* Ta= 150ºC 1000hrs (3000hrs monitoring)*	**336 hrs** Ta=175ºC	N.P.	0/77 x 1 Andorra4M cut 3.0 0/77 x 1 Monco1M5	N.P.	LQFP176: Similarities with Andorra 4M cut 3,0 and Monaco1M5 LQFP144 for CuPd qualification *done only for CuPd qualification
			1000hrs Ta=150ºC	See HTDR trial	0/77 x 2 Andorra4M cut 3.0 0/77 x 2 Monco1M5	0/77 x 3 Andorra 4M cut 3.0	
8	**uHAST** Unbiased Accelerated Stress Test	[JESD22-A118] ☒ AfterJedec PC MSL3 ☒ Testing at Room ☒ Testing at Hot ☐ Testing at Cold ☒ WPT pre / post (first and second bond) * ☒ WBS pre / post * ☒ Visual Inspection * ☒ Cross section * ☒ Drift Analysis * Ta=130°C, 85%RH, 96hrs	**96 hrs**	N.P.	0/77 x 2 Andorra4M cut 3.0 0/77 x 2 Monco1M5	N.P.	LQFP176: Similarities with Andorra 4M cut 3,0 and Monaco1M5 LQFP144 for CuPd qualification *done only for CuPd qualification

4.4 Accelerated Lifetime Simulation Test (Q100 Group B)

Test			Step	Results	Notes
N	TEST NAME	CONDITIONS [SPEC]		Lot 1	
1	**HTOL** High Temp. Operating Life	[JESD22-A108] ☒ After Jedec PC MSL3 ☒ After 1k W/E cyc @125°C ☒ Testing at Room, Hot, Cold ☒ Drift Analysis on Key parameters at Room, Hot, Cold Ta=125ºC, Tj=150°C VDD+20%168hrs + 20k Pon/POff cycles	**168 hrs + 20k Pon/off cyc**	0/77 x 1 0/77 x 3 Andorra 4M cut 3.0	Similarities with Andorra 4M cut 3.0
2	**ELFR** Early Life Failure Rate	[AEC Q100-008] ☒ Testing at Room, Hot, Cold Ta= 125ºC, Tj=150°C, BI+24hrs	**BI+24hrs**	0/800 x 3 Andorra 4M cut 3.0	Similarities with Andorra 4M cut 3.0
3	**HTDR** High Temp. Data Retention	[AEC Q100-005] ☒ After Jedec PC MSL3 ☒ Testing at Room ☒ Testing at Hot ☐ Testing at Cold ☒ After 1k W/E cyc @125°C ☒ Vth Drift Analysis Ta= 150ºC, All0 Pattern 2000hrs	**2000 hrs**	0/77 x 3 Andorra 4M cut 3.0	Similarities with Andorra 4M cut 3.0
4.a	**FET @25°C**	[AEC Q100-005] ☒ Drift Analysis on Flash key parameters at Room, Hot, Cold Ta= 25ºC 100k Write/Erase cyc	**100k cyc**	0/77 x 1 Andorra 4M cut 3.0	Similarities with Andorra 4M cut 3.0
4.b	**HTDR After FET**	☒ Vth Drift Analysis Ta= 150ºC, All0 Pattern 168hrs	**168 hrs**	0/77 x 1 Andorra 4M cut 3.0	Similarities with Andorra 4M cut 3.0
5.a	**FET @125°C**	[AEC Q100-005] ☒ Drift Analysis on Flash key parameters at Room, Hot, Cold Ta= 125ºC 100k Write/Erase cyc	**100k cyc**	0/77 x 3 Andorra 4M cut 3.0	Similarities with Andorra 4M cut 3.0
5.b	**HTDR After FET**	☒ Vth Drift Analysis Ta= 150ºC, All0 Pattern 168hrs	**168 hrs**	0/77 x 3 Andorra 4M cut 3.0	Similarities with Andorra 4M cut 3.0

6.a	**FET @-40°C**	[AEC Q100-005] ☒ Drift Analysis on Flash key parameters at Room, Hot, Cold Ta= -40ºC 100k Write/Erase cyc	**100k cyc**	0/77 x 1 Andorra 4M cut 3.0	Similarities with Andorra 4M cut 3.0
6.b	**HTDR After FET**	☒ Vth Drift Analysis Ta= 150ºC, All0 Pattern 168hrs	**168 hrs**	0/77 x 1 Andorra 4M cut 3.0	Similarities with Andorra 4M cut 3.0
7	**LTDR** Low Temp. Data Retention	[AEC Q100-005] ☒ Vth Drift Analysis After 1k1k W/E cyc @25°C Ta= 60ºC, All0 Pattern 2000hrs	**2000 hrs**	0/77 x 1 Andorra 4M cut 3.0	Similarities with Andorra 4M cut 3.0
8	**LTDR** Low Temp. Data Retention	[AEC Q100-005] ☒ Vth Drift Analysis After 10k W/E cyc @25°C Ta= 60ºC, All0 Pattern 2000hrs	**2000 hrs**	0/77 x 1 Andorra 4M cut 3.0	Similarities with Andorra 4M cut 3.0
9	**LTDR** Low Temp. Data Retention	[AEC Q100-005] ☒ Vth Drift Analysis After 100k W/E cyc @25°C Ta= 60ºC, All0 Pattern 2000hrs	**2000 hrs**	0/77 x 1 Andorra 4M cut 3.0	Similarities with Andorra 4M cut 3.0
10	**Flip Bit**	[AEC Q100-005] ☒ Vth Drift Analysis After 1 W/E cyc @25°C Ta= 25ºC, Chk Pattern 1000hrs	**1000 hrs**	0/77 x 1 Andorra 4M cut 3.0	Similarities with Andorra 4M cut 3.0
11	**Read Disturb**	After 10 W/E cyc @25°C Ta= 25ºC; 4,5V Stress <1ppm after 6000hrs with ECC	**Final**	0/77 x 1 Andorra 4M cut 3.0	Similarities with Andorra 4M cut 3.0
12	**Read Disturb**	After 10k W/E cyc @25°C Ta= 25ºC; 4,5V Stress <1ppm after 1 sec with ECC	**Final**	0/77 x 1 Andorra 4M cut 3.0	Similarities with Andorra 4M cut 3.0

4.5 Package Assembly Integrity Test (Q100 Group C)

Test			Step	Results			Notes
N	TEST NAME	CONDITIONS [SPEC]		LQFP176 (Gold wire)	LQFP176 (CuPd wire)	BGA324 (Gold wire)	
1	**WBS** Wire Bond Shear	[AEC Q100-001] At appropriate time interval for each bonder to be used 30 bonds x 5 devices	**Final result**	Done	Done	Done	
2	**WBP** Wire Bond Pull	[MIL-STD883 method 2011] 30 bonds x 5 devices	**Final result**	Done	Done	Done	
3	**SD** Solderability	[JEDEC JEDES22-B102] > 95% lead coverage	**Final result**	Done	Done	Done	Assy report
4	**PD** Physical Dimension	[JEDEC JEDES22-B100 and B108]	**Final result**	Done	Done	Done	Assy report
5	**SBS** Solder Ball Shear	[AEC Q100-010]	**Final result**	N.A.	N.A.	Done	Not applicable for LQFP package
6	**LI** Lead Integrity	[JEDEC JEDES22-B105]	**Final result**	N.A.	N.A.	N.A.	Not applicable

4.6 Die Fabrication Reliability Test (Q100 Group D)

Test			Step	RESULTS	Notes
N	TEST NAME	CONDITIONS			
1	**EM** Electromigration	The data, test method, calculation and internal criteria should be available to the customer upon request for new technologies	**Final result**	DONE	Process qualification
2	**TDDB** Time Dependent Dielectric Breakdown	The data, test method, calculation and internal criteria should be available to the customer upon request for new technologies	**Final result**	DONE	Process qualification
3	**HCI** Hot Carrier Injection	The data, test method, calculation and internal criteria should be available to the customer upon request for new technologies	**Final result**	DONE	Process qualification
4	**NBTI** Negative Bias Temperature Instability	The data, test method, calculation and internal criteria should be available to the customer upon request for new technologies	**Final result**	DONE	Process qualification
5	**SM** Stress Migration	The data, test method, calculation and internal criteria should be available to the customer upon request for new technologies	**Final result**	DONE	Process qualification

4.7 Electrical Verification Test (Q100 Group E)

Test			Step	RESULTS		Notes
N	TEST NAME	CONDITIONS [AEC Q100]		LQFP176	BGA 324	
1.a	**ESD HBM**	HBM = 2kV	**Final result**	**PASSED 0/3 per V level (no level skip)**	**PASSED 0/3 per V level (no level skip)**	
1.b	**ESD MM**	MM = 200V	**Final result**	**PASSED 0/3 per V level (no level skip)**	**PASSED 0/3 per V level (no level skip)**	
1.c	**ESD CDM**	CDM = 500V / 750V corner only	**Final result**	**PASSED 0/3 per V level (no level skip)**	**PASSED 0/3 per V level (no level skip)**	
2.a	**LU**	Class II - Level A (+/- 100mA)	**Final result**	**PASSED 0/2 per combination**	**PASSED 0/2 per combination**	Total 6 parts per package
2.b	**LU**	Class II - Level A (1,5 x Vmax)	**Final result**	**PASSED 0/2 per combination**	**PASSED 0/2 per combination**	
3	**ED** Electrical Distribution	[AEC Q100-009] ☒ Testing at Room ☒ Testing at Hot ☒ Testing at Cold	**Final result**	DONE		
4	**FG** Fault Grading	[AEC Q100-007] FG shall be = or > 90% for qual units	**Final result**	DONE by Similarity		Andorra 4M Cut 2.0
5	**CHAR** Characterization	[AEC Q103] Performed on new technologies and part families. ☒ Testing at Room ☒ Testing at Hot ☒ Testing at Cold	**Final result**	N.P.		Not required by Q100
6	**GL** Electrothermally-Induced Gate Leakage	[AEC Q100-006] Test before and after GL at room temperature within 96hours of GL stress completion	**Final result**	DONE by Similarity		Andorra 4M Cut 3.0
7	**EMC** Electromagnetic Compatibility	[SAE J1752/3 – radiated Emission]	**Final result**	N.P.		Not required by Q100
8	**SC** Short Circuit Characterization	[AEC Q100-012] Applicable to all smart power devices. This test and statistical evaluation shall be performed per agreement between user and supplier on a case-by-case basis.	**Final result**	N.A.		Not applicable to Microcontroller
9	**SER** Soft Error Rate	[JEDEC Un-accelerated: JESD89-1 or Accelerated: JESD89-2 & JESD89-3] Applicable to devices with memory sizes 1Mbit SRAM or DRAM based cells. Either test option (un-accelerated or accelerated) can be performed, in accordance to the referenced specifications. This test and its accept criteria is performed	**Final result**	DONE by Similarity		Process Qualification

4.8 Defect Screening Test (Q100 Group F)

Test			Step	RESULTS	Notes
N	TEST NAME	CONDITIONS			
1	**PAT** Process Average testing	[AEC Q101]	**Final result**	IMPLEMENTED	
2	**SBA** Statistical Bin/Yield Analysis	[AEC Q102]	**Final result**	IMPLEMENTED	

5 RELIABILITY PLAN AND TESTS RESULTS CUT 3.2

5.1 Conditions

Room test temperature is 25°C
Hot test temperature is 150°C
Cold test temperature is -40°C

5.2 Tables entry legend

Symbol	How to read
☐	Action or condition has not to be considered
☒	The action/condition has been done/applied during the trial
N.P.N.P.	The trial or readout is not in the Qualification Plan and thus has not been performed

5.3 Accelerated Environmental Stress Test (Q100 Group A)

Test			Step	Results			Notes
N	TEST NAME	CONDITIONS [SPEC]		LQFP176 (Gold wire)	LQFP176 (CuPd wire)	BGA324 (Gold wire)	
1	**Pre Conditioning MSL 3**	[J-STD-020] ☒ Testing at Room ☒ Testing at Hot ☒ Testing at Cold* ☒ Sonoscan pre / post ☒ 100 Temperature Cycles 24h bake@125°C, 192h@30°C/60%RH 3x Reflow simulation 260°C Peak Temp	**Post**	0/231 Andorra 4M cut 3.0	0/231 Lot1 0/904 Lot2 0/981 Lot3 Andorra4M cut 3.0 0/231 Lot1 0/904 Lot2 0/981 Lot3 Monaco1M5	0/231 Andorra 4M cut 3.0	LQFP176: Similarities with Andorra 4M cut 3,0 and Monaco1M5 LQFP144 for CuPd qualification *done only for CuPd qualification
2	**THB** Temperature Humidity Bias	[JESD22-A101/A110] ☒ AfterJedec PC MSL3 ☒ Testing at Room ☒ Testing at Hot ☐ Testing at Cold ☒ WPT pre / post (first and second bond) * ☒ WBS pre / post * ☒ Visual Inspection * ☒ Cross section * ☒ Drift Analysis * Ta=85°C, 85%RH, 1000hrs (3000hrs monitoring)*1000hrs (3000hrs monitoring)*	**1000 hrs**	0/77 x 3 Andorra 4M cut 3.0	0/77 x 2 Andorra4M cut 3.0 0/77 x 1 Monco1M5	0/77 x 3 Andorra 4M cut 3.0	LQFP176: Similarities with Andorra 4M cut 3,0 and Monaco1M5 LQFP144 for CuPd qualification *done only for CuPd qualification

3	**THS** Temperature Humidity Storage	[JESD22-A101/A110] ☒ AfterJedec PC MSL3 ☒ Testing at Room ☒ Testing at Hot ☐ Testing at Cold ☒ WPT pre / post (first and second bond) * ☒ WBS pre / post * ☒ Visual Inspection * ☒ Cross section * ☒ Drift Analysis * Ta=85°C, 85%RH, 1000hrs (3000hrs monitoring)*	**1000 hrs**	N.P.	0/77 x 1 Andorra4M cut 3.0 0/77 x 2 Monco1M5	0/77 x 3 Andorra 4M cut 3.0	LQFP176: Similarities with Andorra 4M cut 3,0 and Monaco1M5 LQFP144 for CuPd qualification *done only for CuPd qualification
4	**AC** Autoclave	[JESD22-A102/A118] ☒ AfterJedec PC MSL3 ☒ Testing at Room ☐ Testing at Hot ☐ Testing at Cold ☒ WPT pre / post (first and second bond) * ☒ WBS pre / post * ☒ Visual Inspection * ☒ Cross section * ☒ Drift Analysis * P=2.08atm Ta=121°C, 96hrs	**96 hrs**	0/77 x 3 Andorra 4M cut 3.0	0/77 x 2 Andorra4M cut 3.0 0/77 x 2 Monco1M5	N.P.	LQFP176: Similarities with Andorra 4M cut 3,0 and Monaco1M5 LQFP144 for CuPd qualification *done only for CuPd qualification
5	**TC** Temperature Cycling	[JESD22-A104] ☒ AfterJedec PC MSL3 ☒ Testing at Room ☒ Testing at Hot ☒ Testing at Cold* ☒ Sonoscan pre / post ☒ WPT pre / post (first and second bond) ☒ WBS pre / post * ☒ Visual Inspection * ☒ Cross section * ☒ Cratering test pre/post * ☒ Drift Analysis * Ta=-50°C /+150 °C 1000 cyc (3000cyc monitoring)*	**1000 cyc**	0/77 x 3 Andorra 4M cut 3.0	0/77 x 3 Andorra 4M cut 3.0	0/77 x 3 Andorra 4M cut 3.0	LQFP176: Similarities with Andorra 4M cut 3,0 and Monaco1M5 LQFP144 for CuPd qualification *done only for CuPd qualification
6	**PTC** Power Temperature Cycle	[JESD22-A105] ☐ After Jedec PC MSL3 ☐ Testing at Room ☐ Testing at Hot ☐ Testing at Cold Ta=-40°C /+125 °C 1000 cyc	**1000 cyc**	N.P.	N.P.	N.P.	**Not required on Andorra 4M**

7	**HTSL** High Temperature Storage Lifetime	[JESD22-A103] ☒ AfterJedec PC MSL3 ☒ Testing at Room ☒ Testing at Hot ☐ Testing at Cold ☐ Sonoscan pre / post ☒ WPT pre / post (first and second bond) ☒ WBS pre / post * ☒ Cross section * ☒ Drift Analysis * Ta= 175ºC 336hrs* (500hrs monitoring)* Ta= 150ºC 1000hrs (3000hrs monitoring)*	**336 hrs** Ta=175ºC	N.P.	0/77 x 1 Andorra4M cut 3.0 0/77 x 1 Monco1M5	N.P.	LQFP176: Similarities with Andorra 4M cut 3,0 and Monaco1M5 LQFP144 for CuPd qualification *done only for CuPd qualification
			1000hrs Ta=150ºC	See HTDR trial	0/77 x 2 Andorra4M cut 3.0 0/77 x 2 Monco1M5	0/77 x 3 Andorra 4M cut 3.0	
8	**uHAST** Unbiased Accelerated Stress Test	[JESD22-A118] ☒ AfterJedec PC MSL3 ☒ Testing at Room ☒ Testing at Hot ☐ Testing at Cold ☒ WPT pre / post (first and second bond) * ☒ WBS pre / post * ☒ Visual Inspection * ☒ Cross section * ☒ Drift Analysis * Ta=130°C, 85%RH, 96hrs	**96 hrs**	N.P.	0/77 x 2 Andorra4M cut 3.0 0/77 x 2 Monco1M5	N.P.	LQFP176: Similarities with Andorra 4M cut 3,0 and Monaco1M5 LQFP144 for CuPd qualification *done only for CuPd qualification

5.4 Accelerated Lifetime Simulation Test (Q100 Group B)

Test			Step	Results	Notes
N	TEST NAME	CONDITIONS [SPEC]		Lot 1	
1	**HTOL** High Temp. Operating Life	[JESD22-A108] ☒ After Jedec PC MSL3 ☒ After 1k W/E cyc @125°C ☒ Testing at Room, Hot, Cold ☒ Drift Analysis on Key parameters at Room, Hot, Cold Ta=125ºC, Tj=150°C VDD+20%168hrs + 20k Pon/POff cycles	**168 hrs + 20k Pon/off cyc**	0/77 x 1 0/77 x 3 Andorra 4M cut 3.0	Similarities with Andorra 4M cut 3.0
2	**ELFR** Early Life Failure Rate	[AEC Q100-008] ☒ Testing at Room, Hot, Cold Ta= 125ºC, Tj=150°C, BI+24hrs	**BI+24hrs**	0/800 x 3 Andorra 4M cut 3.0	Similarities with Andorra 4M cut 3.0
3	**HTDR** High Temp. Data Retention	[AEC Q100-005] ☒ After Jedec PC MSL3 ☒ Testing at Room ☒ Testing at Hot ☐ Testing at Cold ☒ After 1k W/E cyc @125°C ☒ Vth Drift Analysis Ta= 150ºC, All0 Pattern 2000hrs	**2000 hrs**	0/77 x 3 Andorra 4M cut 3.0	Similarities with Andorra 4M cut 3.0
4. a	**FET @25°C**	[AEC Q100-005] ☒ Drift Analysis on Flash key parameters at Room, Hot, Cold Ta= 25ºC 100k Write/Erase cyc	**100k cyc**	0/77 x 1 Andorra 4M cut 3.0	Similarities with Andorra 4M cut 3.0
4. b	**HTDR After FET**	☒ Vth Drift Analysis Ta= 150ºC, All0 Pattern 168hrs	**168 hrs**	0/77 x 1 Andorra 4M cut 3.0	Similarities with Andorra 4M cut 3.0
5. a	**FET @125°C**	[AEC Q100-005] ☒ Drift Analysis on Flash key parameters at Room, Hot, Cold Ta= 125ºC 100k Write/Erase cyc	**100k cyc**	0/77 x 3 Andorra 4M cut 3.0	Similarities with Andorra 4M cut 3.0
5. b	**HTDR After FET**	☒ Vth Drift Analysis Ta= 150ºC, All0 Pattern 168hrs	**168 hrs**	0/77 x 3 Andorra 4M cut 3.0	Similarities with Andorra 4M cut 3.0

6.a	**FET @-40°C**	[AEC Q100-005] ☒ Drift Analysis on Flash key parameters at Room, Hot, Cold Ta= -40ºC 100k Write/Erase cyc	**100k cyc**	0/77 x 1 Andorra 4M cut 3.0	Similarities with Andorra 4M cut 3.0
6.b	**HTDR After FET**	☒ Vth Drift Analysis Ta= 150ºC, All0 Pattern 168hrs	**168 hrs**	0/77 x 1 Andorra 4M cut 3.0	Similarities with Andorra 4M cut 3.0
7	**LTDR** Low Temp. Data Retention	[AEC Q100-005] ☒ Vth Drift Analysis After 1k1k W/E cyc @25°C Ta= 60ºC, All0 Pattern 2000hrs	**2000 hrs**	0/77 x 1 Andorra 4M cut 3.0	Similarities with Andorra 4M cut 3.0
8	**LTDR** Low Temp. Data Retention	[AEC Q100-005] ☒ Vth Drift Analysis After 10k W/E cyc @25°C Ta= 60ºC, All0 Pattern 2000hrs	**2000 hrs**	0/77 x 1 Andorra 4M cut 3.0	Similarities with Andorra 4M cut 3.0
9	**LTDR** Low Temp. Data Retention	[AEC Q100-005] ☒ Vth Drift Analysis After 100k W/E cyc @25°C Ta= 60ºC, All0 Pattern 2000hrs	**2000 hrs**	0/77 x 1 Andorra 4M cut 3.0	Similarities with Andorra 4M cut 3.0
10	**Flip Bit**	[AEC Q100-005] ☒ Vth Drift Analysis After 1 W/E cyc @25°C Ta= 25ºC, Chk Pattern 1000hrs	**1000 hrs**	0/77 x 1 Andorra 4M cut 3.0	Similarities with Andorra 4M cut 3.0
11	**Read Disturb**	After 10 W/E cyc @25°C Ta= 25ºC; 4,5V Stress <1ppm after 6000hrs with ECC	**Final**	0/77 x 1 Andorra 4M cut 3.0	Similarities with Andorra 4M cut 3.0
12	**Read Disturb**	After 10k W/E cyc @25°C Ta= 25ºC; 4,5V Stress <1ppm after 1 sec with ECC	**Final**	0/77 x 1 Andorra 4M cut 3.0	Similarities with Andorra 4M cut 3.0

5.5 Package Assembly Integrity Test (Q100 Group C)

Test			Step	Results			Notes
N	TEST NAME	CONDITIONS [SPEC]		LQFP176 (Gold wire)	LQFP176 (CuPd wire)	BGA324 (Gold wire)	
1	**WBS** Wire Bond Shear	[AEC Q100-001] At appropriate time interval for each bonder to be used 30 bonds x 5 devices	**Final result**	Done	Done	Done	
2	**WBP** Wire Bond Pull	[MIL-STD883 method 2011] 30 bonds x 5 devices	**Final result**	Done	Done	Done	
3	**SD** Solderability	[JEDEC JEDES22-B102] > 95% lead coverage	**Final result**	Done	Done	Done	Assy report
4	**PD** Physical Dimension	[JEDEC JEDES22-B100 and B108]	**Final result**	Done	Done	Done	Assy report
5	**SBS** Solder Ball Shear	[AEC Q100-010]	**Final result**	N.A.	N.A.	Done	Not applicable for LQFP package
6	**LI** Lead Integrity	[JEDEC JEDES22-B105]	**Final result**	N.A.	N.A.	N.A.	Not applicable

5.6 Die Fabrication Reliability Test (Q100 Group D)

Test			Step	RESULTS	Notes
N	TEST NAME	CONDITIONS			
1	**EM** Electromigration	The data, test method, calculation and internal criteria should be available to the customer upon request for new technologies	**Final result**	DONE	Process qualification
2	**TDDB** Time Dependent Dielectric Breakdown	The data, test method, calculation and internal criteria should be available to the customer upon request for new technologies	**Final result**	DONE	Process qualification
3	**HCI** Hot Carrier Injection	The data, test method, calculation and internal criteria should be available to the customer upon request for new technologies	**Final result**	DONE	Process qualification
4	**NBTI** Negative Bias Temperature Instability	The data, test method, calculation and internal criteria should be available to the customer upon request for new technologies	**Final result**	DONE	Process qualification
5	**SM** Stress Migration	The data, test method, calculation and internal criteria should be available to the customer upon request for new technologies	**Final result**	DONE	Process qualification

5.7 Electrical Verification Test (Q100 Group E)

Test			Step	RESULTS		Notes
N	TEST NAME	CONDITIONS [AEC Q100]		LQFP176	BGA 324	
1.a	**ESD HBM**	HBM = 2kV	**Final result**	**PASSED 0/3 per V level (no level skip)**	**PASSED 0/3 per V level (no level skip)**	
1.b	**ESD MM**	MM = 200V	**Final result**	**PASSED 0/3 per V level (no level skip)**	**PASSED 0/3 per V level (no level skip)**	
1.c	**ESD CDM**	CDM = 500V / 750V corner only	**Final result**	**PASSED 0/3 per V level (no level skip)**	**PASSED 0/3 per V level (no level skip)**	
2.a	**LU**	Class II - Level A (+/- 100mA)	**Final result**	**PASSED 0/2 per combination**	**PASSED 0/2 per combination**	Total 6 parts per package
2.b	**LU**	Class II - Level A (1,5 x Vmax)	**Final result**	**PASSED 0/2 per combination**	**PASSED 0/2 per combination**	
3	**ED** Electrical Distribution	[AEC Q100-009] ☒ Testing at Room ☒ Testing at Hot ☒ Testing at Cold	**Final result**	DONE		
4	**FG** Fault Grading	[AEC Q100-007] FG shall be = or > 90% for qual units	**Final result**	DONE by Similarity		Andorra 4M Cut 2.0
5	**CHAR** Characterization	[AEC Q103] Performed on new technologies and part families. ☒ Testing at Room ☒ Testing at Hot ☒ Testing at Cold	**Final result**	N.P.		Not required by Q100
6	**GL** Electrothermally-Induced Gate Leakage	[AEC Q100-006] Test before and after GL at room temperature within 96hours of GL stress completion	**Final result**	DONE by Similarity		Andorra 4M Cut 3.0
7	**EMC** Electromagnetic Compatibility	[SAE J1752/3 – radiated Emission]	**Final result**	N.P.		Not required by Q100
8	**SC** Short Circuit Characterization	[AEC Q100-012] Applicable to all smart power devices. This test and statistical evaluation shall be performed per agreement between user and supplier on a case-by-case basis.	**Final result**	N.A.		Not applicable to Microcontroller
9	**SER** Soft Error Rate	[JEDEC Un-accelerated: JESD89-1 or Accelerated: JESD89-2 & JESD89-3] Applicable to devices with memory sizes 1Mbit SRAM or DRAM based cells. Either test option (un-accelerated or accelerated) can be performed, in accordance to the referenced specifications. This test and its accept criteria is performed	**Final result**	DONE by Similarity		Process Qualification

5.8 Defect Screening Test (Q100 Group F)

Test			Step	RESULTS	Notes
N	TEST NAME	CONDITIONS			
1	**PAT** Process Average testing	[AEC Q101]	**Final result**	IMPLEMENTED	
2	**SBA** Statistical Bin/Yield Analysis	[AEC Q102]	**Final result**	IMPLEMENTED	

6 RELIABILITY PLAN AND TESTS RESULTS FOR LASER GROOVE QUALIFICATION ON BGA324

6.1 Conditions

Room test temperature is 25°C
Hot test temperature is 150°C
Cold test temperature is -40°C

6.2 Tables entry legend

Symbol	How to read
☐	Action or condition has not to be considered
☒	The action/condition has been done/applied during the trial
N.P.N.P.	The trial or readout is not in the Qualification Plan and thus has not been performed

6.3 Accelerated Environmental Stress Test (Q100 Group A)

Test			Step	Results			Notes
N	TEST NAME	CONDITIONS [SPEC]		LQFP176 (Gold wire)	LQFP176 (CuPd wire)	BGA324 (Gold wire)	
1	**Pre Conditioning MSL 3**	[J-STD-020] ☒ Testing at Room ☒ Testing at Hot ☒ Testing at Cold* ☒ Sonoscan pre / post ☒ 100 Temperature Cycles 24h bake@125°C, 192h@30°C/60%RH 3x Reflow simulation 260°C Peak Temp	**Post**	N.P.	N.P.	0/231 x 2 Andorra 4M 0/231 x 1 Bolero 3M	Package BGA324: similarities with Bolero 3M BGA256
2	**THB** Temperature Humidity Bias	[JESD22-A101/A110] ☒ AfterJedec PC MSL3 ☒ Testing at Room ☒ Testing at Hot ☐ Testing at Cold ☒ WPT pre / post (first and second bond) * ☒ WBS pre / post * ☒ Visual Inspection * ☒ Cross section * ☒ Drift Analysis * Ta=85°C, 85%RH, 1000hrs	**1000 hrs**	N.P.	N.P.	0/77 x 2 Andorra 4M 0/77 x 1 Bolero 3M	Package BGA324: similarities with Bolero 3M BGA256

3	**THS** Temperature Humidity Storage	[JESD22-A101/A110] ☒ AfterJedec PC MSL3 ☒ Testing at Room ☒ Testing at Hot ☐ Testing at Cold ☒ WPT pre / post (first and second bond) * ☒ WBS pre / post * ☒ Visual Inspection * ☒ Cross section * ☒ Drift Analysis * Ta=85°C, 85%RH, 1000hrs	**1000 hrs**	N.P.	N.P.	0/77 x 2 Andorra 4M 0/77 x 1 Bolero 3M	Package BGA324: Similarities with Bolero 3M BGA256
4	**AC** Autoclave	[JESD22-A102/A118] ☒ AfterJedec PC MSL3 ☒ Testing at Room ☐ Testing at Hot ☐ Testing at Cold ☒ WPT pre / post (first and second bond) * ☒ WBS pre / post * ☒ Visual Inspection * ☒ Cross section * ☒ Drift Analysis * P=2.08atm Ta=121°C, 96hrs	**96 hrs**	N.P.	N.P.	N.P.	
5	**TC** Temperature Cycling	[JESD22-A104] ☒ AfterJedec PC MSL3 ☒ Testing at Room ☒ Testing at Hot ☒ Testing at Cold* ☒ Sonoscan pre / post ☒ WPT pre / post (first and second bond) ☒ WBS pre / post * ☒ Visual Inspection * ☒ Cross section * ☒ Cratering test pre/post * ☒ Drift Analysis * Ta=-50°C /+150 °C 1000 cyc (3000cyc monitoring)*	**1000 cyc**	N.P.	N.P.	0/77 x 2 Andorra 4M 0/77 x 1 Bolero 3M	Package BGA324: Similarities with Bolero 3M BGA256
6	**PTC** Power Temperature Cycle	[JESD22-A105] ☐ After Jedec PC MSL3 ☐ Testing at Room ☐ Testing at Hot ☐ Testing at Cold Ta=-40°C /+125 °C 1000 cyc	**1000 cyc**	N.P.	N.P.	N.P.	Not required on Andorra 4M

7	**HTSL** High Temperature Storage Lifetime	[JESD22-A103] ☐ AfterJedec PC MSL3 ☒ Testing at Room ☒ Testing at Hot ☐ Testing at Cold ☐ Sonoscan pre / post ☒ WPT pre / post (first and second bond) ☒ WBS pre / post * ☒ Cross section * ☒ Drift Analysis * Ta= 175ºC 336hrs* Ta= 150ºC 1000hrs	**336 hrs** Ta=175ºC	N.P.	N.P.	N.P.	Package BGA324: Similarities with Bolero 3M BGA256
			1000hrs Ta=150ºC	N.P.	N.P.	0/77 x 2 Andorra 4M 0/77 x 1 Bolero 3M	
8	**uHAST** Unbiased Accelerated Stress Test	[JESD22-A118] ☒ AfterJedec PC MSL3 ☒ Testing at Room ☒ Testing at Hot ☐ Testing at Cold ☒ WPT pre / post (first and second bond) * ☒ WBS pre / post * ☒ Visual Inspection * ☒ Cross section * ☒ Drift Analysis * Ta=130°C, 85%RH, 96hrs	**96 hrs**	N.P.	N.P.	N.P.	

7 REVISION TRACKING

Rev 3.4
1. BGA256 Laser Groove qualification: reliability trials completed

Rev 3.3
1. PMU Bypass fix qualification

Rev 3.2
1. POR fix qualification on BGA324 added

Rev 3.1
1. POR fix qualification added

Rev 3.0
1. Third Document release: BGA324 package qualification results added

Rev 2.1
1. Typo error fixed in page 8 for ELFR quantity in trial

Rev 2.0
1. Second Document release: CuPd wire qualification of LQFP176 added

Rev 1.0
1. First document release