PRODUCT / PROCESS CHANGE NOTIFICATION

1. PCN basic data	
1.1 Company	STMicroelectronics International N.V
1.2 PCN No.	ADG/18/10726
1.3 Title of PCN	Conversion from 4” to 6” of Automotive-grade 1200V SiC Schottky diodes production line
1.4 Product Category	automotive-grade 1200V SiC Schottky diodes
1.5 Issue date	2018-02-12

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	Richard RENARD
2.1.2 Marketing Manager	Franck DUCLOS
2.1.3 Quality Manager	Jean-Paul REBRASSE

3. Change		
3.1 Category	3.2 Type of change	3.3 Manufacturing Location
General	Wafer diameter modification	ST diffusion site in Catania

4. Description of change		
	Old	New
4.1 Description	4 inches wafers	6 inches wafers
4.2 Anticipated Impact on form,fit, function, quality, reliability or processability?	no	

5. Reason / motivation for change	
5.1 Motivation	Capacity extension with 6’’ conversion and 4’’ production line phase out
5.2 Customer Benefit	CAPACITY INCREASE

6. Marking of parts / traceability of change	
6.1 Description	internal codifications and QA number

7. Timing / schedule	
7.1 Date of qualification results	2018-02-08
7.2 Intended start of delivery	2018-07-30
7.3 Qualification sample available?	Upon Request

8. Qualification / Validation			
8.1 Description			
8.2 Qualification report and qualification results	In progress	Issue Date	

9. Attachments (additional documentations)
10726 Public product.pdf 10726 Draft PCN 6 inch conversion of 1200V SiC diodes - AUTO.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
	STPSC10H12DY	
	STPSC10H12GY-TR	
	STPSC15H12DY	
	STPSC20H12DY	
	STPSC20H12GY-TR	

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STMicroelectronics
ADG - ASD & IPAD™ Division[1]
BU Rectifier

(1) ADG: Automotive and Discretes Group - ASD: Application Specific Device – IPAD™: Integrated Passive and Active Devices

PCN
Product/Process Change Notification

Conversion from 4” to 6” of Automotive-grade 1200V SiC Schottky diodes production line

Notification number:	ADG-DIS/18/10726	**Issue Date**	08/02/2018
Issued by	Aline AUGIS		
Product series affected by the change:		**1200V Power Schottky SiC diodes**	
Type of change:		Front end realization	

Description of the change

Wafer diameter conversion from 4’’ (100mm) to 6’’ (150mm) for 1200V Power Schottky SiC diodes

Reason for change

Capacity extension with 6’’ conversion and 4’’ production line phase out

Former versus changed product:	The changed products do not present modified electrical, dimensional or thermal parameters, leaving unchanged the current information published in the product datasheet The Moisture Sensitivity Level of the part (according to the IPC/JEDEC JSTD-020D standard) remains unchanged. The footprint recommended by ST remains the same. There is no change in the packing modes and the standard delivery quantities either. The products remain in full compliance with the ST ECOPACK®2 grade (“halogen-free”).

Disposition of former products

Units of current production with 4’’ wafers will be delivered until stock depletion.

Marking and traceability

The traceability is ensured by the creation of new internal codifications (Finish good) and by the QA number. Example of FG code here below:

Sales type	4’’ Finished Good code	6’’ Finished good code
STPSC10H12DY	YPSC10H12D/7	YPSC10H12DE6/7

Qualification complete forecasted date	Week 19-2018

Forecasted sample availability

Product family	Sub-family	Commercial part Number	Availability date
Rectifiers	SiC Power Schottky	STPSCxxH12xx	See pages 3 to 5

Change implementation schedule

Sales types	Estimated production start	Estimated first shipments
STPSCxxH12xx	Week 05- 2018	Week 31- 2018

Due to very strong demand, silicon carbide diode capacity is extended with 4'' to 6'' conversion. Expected full conversion date is W19-2018.

Comments:	Shipments can be anticipated before W31-2018 upon customer acceptance.

Customer's feedback

Please contact your local ST sales representative or quality contact for requests concerning this change notification.
According JEDEC JESD46, absence of acknowledgement of this PCN within 60 days of receipt will constitute acceptance of the change.
Absence of additional response within 180 days of receipt of this PCN will constitute acceptance of the change.
In case of late acceptance or reject of this PCN, STMicroelectronics will not be able to deliver units from 4'' production to customer any more once 4'' production terminated and 4'' stock fully depleted.

Qualification program and results	17092QRP Attached

Samples availability date

Commercial product	Availability date
STPSC10H12DY	Available
STPSC10H12GY-TR	Available
STPSC15H12DY	Available
STPSC20H12DY	W10
STPSC20H12GY-TR	W10

Reliability Evaluation Report

Qualification of SiC Power Schottky 600V, 650V and 1200V
6 inches (150mm) conversion for wafer diameter

General Information	
Product Line	*Rectifiers*
Product Description	*SiC Power Schottky 600V* *SiC Power Schottky 650V* *SiC Power Schottky 1200V*
Product perimeter	*STPSCxx06x* *STPSCxx065x / STPSCxx065xY* *STPSCxx12x / STPSCxx12xY*
Product Group	*ADG*
Product division	*ASD&IPAD*
Package	*Multiple*
Maturity level step	*QUALIFIED* (600V-650V perimeter) UNDER QUALIFICATION (1200V perimeter)

Locations	
Wafer fab	*ST Catania - ITALY*
Assembly plant	*Multiple*
Reliability Lab	*ST TOURS - FRANCE*
Reliability assessment	PASS (600V-650V perimeter) IN-PROGRESS (1200V perimeter)

DOCUMENT INFORMATION

Version	Date	Pages	Prepared by	Approved by	Comments
1.0	30-Nov-2017	7	Isabelle BALLON	Julien MICHELON	Initial release: qualification of 6 inches diameter wafer conversion for SiC 600V and 650V perimeter
1.1	05-Feb-2018	8			Qualification plan for SiC 1200V perimeter

TABLE OF CONTENTS

1 APPLICABLE AND REFERENCE DOCUMENTS

Document reference	Short description
AEC-Q101 (rev. D1)	Stress test qualification for automotive grade discrete semiconductors
JESD 47	Stress-Test-Driven Qualification of Integrated Circuits
JESD 94	Application specific qualification using knowledge based test methodology
JESD 22	Reliability test methods for packaged devices

2 GLOSSARY

SS	Sample Size
HTRB	High Temperature Reverse Bias
TC	Temperature Cycling
THB	Temperature Humidity Bias
DPA	Destructive Physical Analysis
PCT/AC	Pressure Cooker Test (Autoclave)
IOLT	Intermittent Operating Life Test
PC	Pre-conditioning (before test)
GD	Generic Data

3 RELIABILITY EVALUATION OVERVIEW

3.1 Objectives

The objective of this report is to qualify 6inches wafer diameter conversion for SiC 600V, 650V and 1200V Power Schottky products assembled in all available packages.

The product series involved in this qualification are listed below.

Product sub-Family	Product devices
Silicon Carbide Power Schottky Rectifiers 600V & 650V	All STPSCxx 600V & 650V (STPSCxx06x – STPSxx065x – STPSCxx065xY)
Silicon Carbide Power Schottky Rectifiers 1200V	All STPSCxx 1200V (STPSCxx12x – STPSCxx12xY)

The reliability test methodology used follows the JESD47-H and AEC-Q101 RevD1: « Stress Test Driven Qualification Methodology » The following reliability tests ensuing are:

- HTRB to evaluate the risk of contamination from the resin and the assembly process versus the die layout sensitivity.
- TC and IOLT to ensure the mechanical robustness of the products.
- THB and PCT to check the robustness to corrosion and the good package hermeticity

Similarity methodology is used. See 5.1 “comments” for more details about similarities.

3.2 Conclusion

Qualification Plan requirements for SiC 600V-650V perimeter have been fulfilled without exception. Reliability tests have shown that the devices behave correctly against environmental tests (no failure). Moreover, the stability of electrical parameters during the accelerated tests demonstrates the robustness of the products and safe operation, which is consequently expected during their lifetime.

Qualification Plan is in progress for SiC 1200V perimeter.

4 DEVICE CHARACTERISTICS

4.1 Change description

No change in terms of performances.
The process key parameters comparison and the different tests have shown that there is no impact on electrical results of the products with the reference to their datasheet.

4.2 Construction Note

	STPSCxx06x **STPSCxx065x – STPSCxx065xY** **STPSCxx12x – STPSCxx12xY**
Wafer/Die fab. information	
Wafer fab manufacturing location	ST Catania - ITALY
Technology / Process family	SiC 600V Power Schottky SiC 650V Power Schottky SiC 1200V Power Schottky
Wafer Testing (EWS) information	
Electrical testing manufacturing location	ST Catania - ITALY
Assembly information	
Assembly site	Multiple
Package description	Multiple
Final testing information	
Testing location	Multiple

5 TESTS RESULTS SUMMARY

5.1 Test vehicles

Silicon Carbide Power Schottky Rectifiers 600V & 650V perimeter:

Lot #	Part Number	Package	Comments
L1a	STPSC406D	TO-220AC	1st Qualification lot - SiC 600V
L1b			
L2a	STPSC20065DY	TO-220AC	2nd Qualification lot - SiC 650V Blank serie Automotive Grade
L2b			
L3a	STPSC20H065CWY	TO-247	3rd Qualification lot - SiC 650V H serie Automotive Grade
L3b			

Silicon Carbide Power Schottky Rectifiers 1200V perimeter:

Lot #	Part Number	Package	Comments
L4a	STPSC6H12B-TR	DPAK	1st Qualification lot SiC 1200V
L4b			
L5a	STPSC20H12DY	TO-220AC	2nd Qualification lot SiC 1200V - Automotive Grade
L5b			
L6	STPSC20H12D	TO-220AC	3rd Qualification lot SiC 1200V
L7	STPSC10H12GY-TR	D^2PAK	4th Qualification lot SiC 1200V - Automotive Grade
L8	STPSC15H12WL	DO-247 LL	5th Qualification lot SiC 1200V
L9	STPSC6H12B-TR	DPAK	6th Qualification lot SiC 1200V

Detailed results in below chapter will refer to these references.

5.2 Test plan and results summary

Silicon Carbide Power Schottky Rectifiers 600V & 650V perimeter:

Test	Std ref.	Test conditions	SS total	Steps / duration	Failure/SS					
					L1a	L1b	L2a	L2b	L3a	L3b
Die Oriented										
HTRB	MIL-STD-750-1 M1038 Method.A	VR = VRRM Tj ≥ 175°C (Ta=175°C)	462	1Khrs	0/77	0/77	0/77	0/77	0/77	0/77
Package Oriented										
THB	JESD22 A-101	85% RH, 85°C VR=100V	231	1Khrs	0/77		0/77		0/77	
DPA after THB	AEC-Q101-004	-	2	-			0/2			
PCT	JESD22 A-102	121°C 2bar 100% RH	154	96hrs	0/77				0/77	
TC	JESD22 A-104	-65/+150°C 2 cy/h	308	1Kcy	0/77		0/77	0/77	0/77	
DPA after TC	AEC-Q101-004	-	2	-			0/2			
IOLT	MIL-STD-750 method 1037	ΔTj = 100°C t_{on} = t_{off} = 210s (for L1a-L2a: TO-220AC)	231	8572cy (TO-220AC)	0/77		0/77			
		ΔTj = 100°C t_{on} = t_{off} = 300s (for L3: TO-247)		6000cy (TO-247)					0/77	

Silicon Carbide Power Schottky Rectifiers 1200V perimeter:

Test	Std ref.	Test conditions	SS total	Steps / duration	Failure/SS							
					L4a	L4b	L5a	L5b	L6	L7	L8	L9
Die Oriented												
HTRB	MIL-STD-750-1 M1038 Method.A	VR = VRRM Tj ≥ 175°C (Ta=175°C)	154	1Khrs			0/77	0/77				
Package Oriented												
THB	JESD22 A-101	85% RH, 85°C VR=100V	231	1Khrs	0/77	0/77	0/77					
DPA after THB	AEC-Q101-004	-	2	-	Refer to above (test vehicle L2a)							
PCT	JESD22 A-102	121°C 2bar 100% RH	In-progress	96hrs					0/77	w09-2018	w09-2018	w09-2018
TC	JESD22 A-104	-65/+150°C 2 cy/h	In-progress	1Kcy					0/77	w10-2018	w10-2018	w10-2018
DPA after TC	AEC-Q101-004	-	2	-	Refer to above (test vehicle L2a)							
IOLT	MIL-STD-750 method 1037	ΔTj = 100°C t_{on} = t_{off} = 210s (for L6-L7: TO-220AC, D²PAK)	In-progress	8572cy					0/77	w13-2018		
		ΔTj = 100°C t_{on} = t_{off} = 300s (for L8: DO-247 LL)		6Kcy							w13-2018	
		ΔTj = 100°C t_{on} = t_{off} = 120s (for L9: DPAK)		15Kcy								w13-2018

Note: PCT, THB, TC, IOLT tests are performed after MSL1 pre-conditioning for surface-mounting vehicles: L4x, L7, L9.

6 ANNEXES

6.1 Tests description

Test name	Description	Purpose
Die-oriented		
HTRB High Temperature Reverse Bias	The device is stressed in static configuration, trying to satisfy as much as possible the following conditions: low power dissipation; max. supply voltage compatible with diffusion process and internal circuitry limitations	To determine the effects of bias conditions and temperature on solid state devices over time. It simulates the devices' operating condition in an accelerated way. To maximize the electrical field across either reverse-biased junctions or dielectric layers, in order to investigate the failure modes linked to mobile contamination, oxide ageing, layout sensitivity to surface effects.
Package-oriented		
THB Temperature Humidity Bias	The device is biased in static configuration minimizing its internal power dissipation, and stored at controlled conditions of ambient temperature and relative humidity.	To evaluate the package moisture resistance with electrical field applied, both electrolytic and galvanic corrosion are put in evidence.
TC Temperature Cycling	The device is submitted to cycled temperature excursions, between a hot and a cold chamber in air atmosphere.	To investigate failure modes related to the thermo-mechanical stress induced by the different thermal expansion of the materials interacting in the die-package system. Typical failure modes are linked to metal displacement, dielectric cracking, molding compound delamination, wire-bonds failure, die-attach layer degradation.
DPA Destructive Physical Analysis	Specific construction analysis on random parts that have successfully completed THB or TC.	To investigate on reliability stresses impact on delamination, corrosion and product construction integrity.
PCT Pressure Cooker Test (Autoclave)	The device is stored in saturated steam, at fixed and controlled conditions of pressure and temperature.	To investigate corrosion phenomena affecting die or package materials, related to chemical contamination and package hermeticity.
IOLT Intermittent Operating Life Test	All test samples shall be subjected to the specified number of cycles. When stabilized after initial warm-up cycles, a cycle shall consist of an "on" period, when power is applied suddenly, not gradually, to the device for the time necessary to achieve a delta case temperature of +85°C (+15°C, -5°C), followed by an off period, when the power is suddenly removed, for cooling the case through a similar delta temperature.	The purpose of this test is to determine compliance with the specified numbers of cycles for devices subjected to the specified conditions. It accelerates the stresses on all bonds and interfaces between the chip and mounting face of devices subjected to repeated turn on and off of equipment and is therefore most appropriate for case mount style (e.g., stud, flange, and disc) devices.