PCN
Product/Process Change Notification

Conversion of SiC Diodes 650V in DPAK & D²PAK to ECOPACK®2 Molding Compound

Notification number:	ADG-DIS/20/11976	**Issue Date**	28/01/2020
Issued by	Aline Augis		
Product series affected by the change		STPSC4H065B-TR STPSC6H065B-TR STPSC8H065B-TR STPSC10H065B-TR STPSC6H065G-TR STPSC8H065G-TR STPSC10H065G-TR	
Type of change		Back End realization	

Description of the change

STMicroelectronics is upgrading the SiC 650V Diodes assembled in DPAK and D²PAK packages and listed in this document from ECOPACK®1 to ECOPACK®2, in order to comply with so-called “Halogen-free” requirement.

Reason for change

Latest new SiC 650V diodes housed in DPAK and D²PAK, industrial grade, are already ECOPACK®2 compliant. All the 650V SiC diodes in Automotive Grade were qualified as ECOPACK®2 as well.
STMicroelectronics has decided to upgrade all the SiC 650V Diodes listed above to ECOPACK®2 level.
ECOPACK®2 means that on the top of being RoHS compliant, the products affected by this change, will turn to be free of brominated, chlorinated and antimony-oxide flame retardants.

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. There is no change in the packing modes and the standard delivery quantities either.

	The products will be upgraded from ECOPACK®1 to ECOPACK®2 grade (“halogen-free”).

Disposition of former products

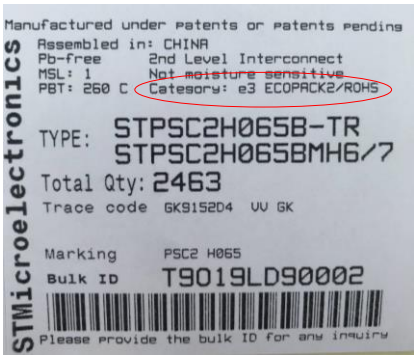
Delivery of current product will be done until stock depletion.

Marking and traceability

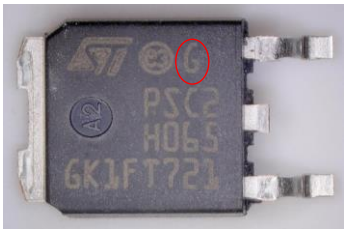
New Finished good codes are created for ECOPACK®2 product versions. Below are the codifications.

Sales types	ECOPACK®1 Finished Good codes	ECOPACK®2 Finished Good codes
STPSC4H065B-TR	PSC4H065BM6/7	PSC4H065BM**H**6/7
STPSC6H065B-TR	PSC6H065BM6/7	PSC6H065BM**H**6/7
STPSC8H065B-TR	PSC8H065BRM6/71	PSC8H065BM**H**6/71
STPSC10H065B-TR	PSC10H065BM6/71	PSC10H065BM**H**6/7
STPSC6H065G-TR	PSC6H065GM6/7	PSC6H065GM**H**6/7
STPSC8H065G-TR	STPSC8H065GM6/7	STPSC8H065GM**H**6/7
STPSC10H065G-TR	PSC10H065GM6/7	PSC10H065GM**H**6/7

Label will evidence that new products will be ECOPACK2/RoHS.



Product marking will show a ‘G’ that stands for Green on these Halogen–Free products.



Qualification complete date	Week 05-2020

Forecasted sample availability

Product family	Sub-family	Commercial part Number	Availability date
SiC Diodes 650V	DPAK	STPSC4H065B-TR	April 2020
	DPAK	STPSC6H065B-TR	6 weeks after request
	DPAK	STPSC8H065B-TR	6 weeks after request
	DPAK	STPSC10H065B-TR	6 weeks after request
	D2PAK	STPSC6H065G-TR	6 weeks after request
	D2PAK	STPSC8H065G-TR	6 weeks after request
	D2PAK	STPSC10H065G-TR	6 weeks after request

Change implementation schedule

Sales types	Estimated production start	Estimated first shipments
All	Week 15-2020	Week 19-2020

Comments:	Shipments can start earlier according customer approval of the PCN

Customer's feedback

Please contact your local ST sales representative or quality contact for requests concerning this change notification.
Absence of acknowledgement of this PCN within 30 days of receipt will constitute acceptance of the change
Absence of additional response within 90 days of receipt of this PCN will constitute acceptance of the change

Qualification program and results	20006QRP Rev 1 Attached

Reliability Evaluation Report
Conversion of SiC Diodes 650V in DPAK & D²PAK to Halogen-free Molding Compound

General Information	
Product Line	*Rectifiers*
Product Description	650 V power Schottky silicon carbide rectifier
Product perimeter	*STPSC4H06B-TR* *STPSC6H065B-TR* *STPSC8H065B-TR* *STPSC10H065B-TR* *STPSC6H065G-TR* *STPSC8H065G-TR* *STPSC10H065G-TR*
Product Group	*ADG*
Product division	*Discrete & Filter*
Package	*DPAK* *D²PAK*
Maturity level step	*Qualified*

Locations	
Wafer fab	*ST CATANIA - ITALY*
Assembly plant	*ST SHENZHEN - CHINA*
Reliability Lab	*ST TOURS - FRANCE*
Reliability assessment	Pass

DOCUMENT INFORMATION

Version	Date	Pages	Prepared by	Approved by	Comments
1.0	13-Jan-2020	8	Isabelle BALLON	Julien MICHELON	Initial release: Conversion of remaining SiC diodes 650V in DPAK & D²PAK to ECOPACK®2 (Halogen-free) Molding compound

Note: This report is a summary of the reliability trials performed in good faith by STMicroelectronics in order to evaluate the potential reliability risks during the product life using a set of defined test methods.
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TABLE OF CONTENTS

1 APPLICABLE AND REFERENCE DOCUMENTS

Document reference	Short description
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
THB/H3TRB	Temperature Humidity Bias/High Humidity High Temperature Reverse Bias
TC	Temperature Cycling
AC/PCT	Autoclave / Pressure Cooker Test
IOLT	Intermittent Operating Life Test
RSH	Resistance to Soldering Heat
SD	Solderability
DBT	Deag Bug Test
TW	Tin Whiskers
GD	Generic Data

3 RELIABILITY EVALUATION OVERVIEW

3.1 Objectives

The objective of this report is to qualify the conversion of remaining STPSCxH065B-TR & STPSCxH065G-TR products, 650V SiC Power Schottky embedded in DPAK & D²PAK packages in Green Molding (Halogen-free) compound.
List of involved products:

Commercial Product	Package	Comment
STPSC4H065B-TR STPSC6H065B-TR STPSC8H065B-TR STPSC10H065B-TR	DPAK	Industrial product
STPSC6H065B-TR STPSC8H065B-TR STPSC10H065B-TR	D²PAK	Industrial product

The reliability test methodology used follows the JESD47: « Stress Test riven Qualification Methodology » and AECQ-101 revD1 guidelines.

- TC and IOLT to ensure the mechanical robustness of the products.
- HTRB to evaluate the risk of contamination from the resin and the assembly process versus the die layout sensitivity.
- THB/H3TRB, AC to check the robustness to corrosion and the good package hermeticity.
- Solderability and DBT to check compatibility of package with customer assembly.
- Tin Whiskers to check lead-finishing quality.

3.2 Conclusion

Qualification Plan requirements 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.

4 DEVICE CHARACTERISTICS

4.1 Device description

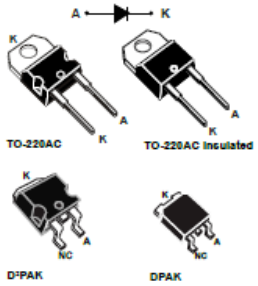
Refer to products datasheets.
Example here below:

life.augmented

STPSC8H065

Datasheet

650 V, 8 A high surge silicon carbide power Schottky diode



Features

- No reverse recovery charge in application current range
- Switching behavior independent of temperature
- High forward surge capability
- Insulated package TO-220AC Ins:
  - Insulated voltage: 2500 V_{RMS}
  - Typical package capacitance: 7 pF
- Power efficient product

Applications

- Switch mode power supply
- PFC
- DCDC converters
- LLC topologies
- Boost diode

Description

This 8 A, 650 V SiC diode is an ultrahigh performance power Schottky diode. It is manufactured using a silicon carbide substrate. The wide band gap material allows the design of a Schottky diode structure with a 650 V rating. Due to the Schottky construction, no recovery is shown at turn-off and ringing patterns are negligible. The minimal capacitive turn-off behavior is independent of temperature.

This STPSC8H065 is especially suited for use in PFC applications. This ST SiC diode will boost the performance in hard switching conditions. Its high forward surge capability ensures a good robustness during transient phases.

Product status
STPSC8H065

Product summary	
Symbol	**Value**
$I_{F(AV)}$	8 A
V_{RRM}	650 V
$T_{j(max.)}$	175 °C

Product label
SUSTAINABLE TECHNOLOGY

4.2 Construction Note

	STPSCxxH065B-TR STPSCxH065G-TR
Wafer/Die fab. information	
Wafer fab manufacturing location	ST Catania - ITALY
Technology / Process family	650 V power Schottky silicon carbide diode
Wafer Testing (EWS) information	
Electrical testing manufacturing location	ST Catania - ITALY
Assembly information	
Assembly site	ST SHENZHEN - CHINA
Package description	DPAK D²PAK
Molding compound	ECOPACK®2 compliant component
Lead finishing/bump solder material	Pure Tin
Final testing information	
Testing location	ST SHENZHEN - CHINA

5 TESTS RESULTS SUMMARY

5.1 Test vehicles

Lot #	Commercial Product	Package	Comments
GD1	STPSC10H065BY-TR	DPAK	Generic data. Same technology. Same package (same resin, same wire material and diameter. Bigger die more critical vs thermal-mechanical stress and humidity)
GD2	STPSC10H065GY-TR	D²PAK	Generic data. Same technology. Same package (same resin, same wire material and diameter. Bigger die more critical vs thermal-mechanical stress and humidity)
GD3	STPSC10H065GY-TR	D²PAK	Generic data. Same technology. Same package (same resin, same wire material and diameter. Bigger die more critical vs thermal-mechanical stress and humidity)
GD4	STPSC10H065GY-TR	D²PAK	Generic data. Same technology. Same package (same resin, same wire material and diameter. Bigger die more critical vs thermal-mechanical stress and humidity)

Detailed results in below chapter will refer to these references.

5.2 Test plan and results summary

Test	Std ref.	Conditions	Steps / Duration	SS	Failure/SS			
					GD1	GD2	GD3	GD4
Die Oriented Tests								
HTRB	JESD22-A108 MIL-STD-750-1 M1038 Method A	VR = 650V Tj=175°C	1Khrs	154	0/77			
		VR = 520V Tj=150°C	1Khrs			0/77		
Package Oriented Tests								
TC	JESD 22A-104	-65/+150°C 2cy/h	1Kcy	154	0/77		0/77	
THB/H3TRB	JESD22 A-101	85°C; 85% RH VR=100V	1Khrs	154	0/77	0/77		
AC/PCT	JESD22 A-102	121°C, 2bar	96hrs	154	0/77	0/77		
IOLT	MIL-STD-750 Method 1037	ΔTj=100°C Ton=120s, Toff=120s	1Khrs	154	0/77			0/77
RSH	JESD22 B-111 (SMD)	THS 85%RH / 85°C 168hrs Sn/Pb dipping 260°C	-	-	(*)			
DBT	DM00112629 (ST internal)	IR reflow after flux deposition	-	60	0/30	0/30		
SD	J-STD-002 JESD22 B-102	Dry ageing SnPb bath 220°C	-	20	0/10	0/10		
		Wet ageing SnPb bath 220°C	-	20	0/10	0/10		
		Dry ageing SnAgCu bath 245°C	-	10	0/10	0/10		
		Wet ageing SnAgCu bath 245°C	-	10	0/10	0/10		
TW	JESD201	No reflow 30°C/60%RH	4Khrs	27	0/9 (3 lots)			
		No reflow 55°C/85%RH	4Khrs	27	0/9 (3 lots)			
		No reflow -40°C/85°C	1.5Khrs	27	0/9 (3 lots)			
		Reflow SnPb 215°C 30°C/60%RH	4Khrs	27	0/9 (3 lots)			
		Reflow SnPb 215°C 55°C/85%RH	4Khrs	27	0/9 (3 lots)			
		Reflow SnPb 215°C -40°C/85°C	1.5Khrs	27	0/9 (3 lots)			
		Reflow Pb Free 245°C 30°C/60%RH	4Khrs	27	0/9 (3 lots)			
		Reflow Pb Free 245°C 55°C/85%RH	4Khrs	27	0/9 (3 lots)			
		Reflow Pb Free 245°C -40°C/85°C	1.5Khrs	27	0/9 (3 lots)			

Note: Package-oriented tests (except RSH, SD and DBT) are submitted to preconditioning (PC) before test.

* Package not eligible to this test as per JESD22 A-111 (large die paddle).

6 ANNEXES

6.1 Tests description

Test name	Description	Purpose
Die Oriented		
HTRB High Temperature Reverse Bias	The diode is biased in static reverse mode at targeted junction temperature.	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/H3TRB Temperature Humidity Bias / High Humidity High Temperature Reverse 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.
AC 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 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.
RSH Resistance to Soldering Heat	Package is dipped by the leads in a solder bath after an initial wet ageing (for SMDs only). Assessment by electrical test and visual inspection (no external crack).	To simulate wave soldering process and verify that package will not be thermally damaged during this step.
SD Solderability	Ageing + dipping in a solder bath. Assessment by visual inspection of the leads.	To ensure good wettability of the leads
DBT Dead Bug Test	To evaluate the wettability of the package leads. Good indicator to determine the bad solderability behavior	Components are glued up-side down on a substrate. Pins are wetted with a moderately activated flux. Then run once through the reflow oven with leadfree temperature profile. Visual inspection is performed with suitable tool.
TW Tin Whiskers	Forced growing of Tin Whiskers by various kind of environmental stress: temperature, moisture and temperature cycling	To ensure no risk of electrical short due to Tin Whisker growth