PRODUCT / PROCESS CHANGE NOTIFICATION

1. PCN basic data	
1.1 Company	STMicroelectronics International N.V
1.2 PCN No.	ADG/22/13207
1.3 Title of PCN	SM6T220A TVS die dimensions rationalization
1.4 Product Category	SM6T220A
1.5 Issue date	2022-01-26

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	Stephane CHAMARD
2.1.2 Marketing Manager	Philippe LEGER
2.1.3 Quality Manager	Jean-Paul REBRASSE

3. Change		
3.1 Category	3.2 Type of change	3.3 Manufacturing Location
General Product & Design	Die redesign: Mask or mask set change with new die design – Pad modification (sizes, vertical structure, metal thickness)	STMicroelectronics Tours - France (Die manufacturing)

4. Description of change		
	Old	New
4.1 Description	Former dimensions	Dimensions rationalization
4.2 Anticipated Impact on form,fit, function, quality, reliability or processability?	No	

5. Reason / motivation for change	
5.1 Motivation	In the frame of dice size rationalization, STMicroelectronics has decided to change die dimensions for SM6T220A (unidirectional TVS) to standardize die design versus bidirectional product. New die dimensions are already in mass production for SM6T220CA (bidirectional TVS product).
5.2 Customer Benefit	MANUFACTURING FLEXIBILITY

6. Marking of parts / traceability of change	
6.1 Description	Traceability of the change will be ensured by Finished Good/Type (SM6T220AH-NH) print on carton labels.

7. Timing / schedule	
7.1 Date of qualification results	2022-01-24
7.2 Intended start of delivery	2022-05-02
7.3 Qualification sample available?	Upon Request

8. Qualification / Validation			
8.1 Description	13207 22004QRP.pdf		
8.2 Qualification report and qualification results	Available (see attachment)	Issue Date	2022-01-26

9. Attachments (additional documentations)
13207 Public product.pdf 13207 PCN SM6T220A.pdf 13207 22004QRP.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
SM6T220A	SM6T220A	

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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 : SM6T220A TVS die dimensions rationalization

PCN Reference : ADG/22/13207

Subject : Public Products List

Dear Customer,

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

SM6T220A		

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(1) ADG: Automotive and Discrete Group

PCN
Product/Process Change Notification

SM6T220A TVS die dimensions rationalization

Notification number:	ADG/22/13207	**Issue Date**	24-Jan-2022
Issued by	Isabelle BALLON		
Product series affected by the change		SM6T220A	
Type of change		Product and Design	

Description of the change

Rationalization of die dimensions.

Reason for change

In the frame of dice size rationalization, STMicroelectronics has decided to change die dimensions for SM6T220A (unidirectional TVS) to standardize die size versus bidirectional product.
New die dimensions are already in mass production for SM6T220CA (bidirectional TVS product).

Former versus changed product:	The changed product does 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 (so called “halogen-free”).

Disposition of former products

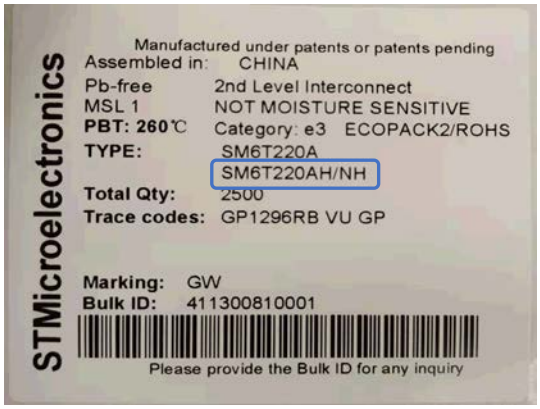
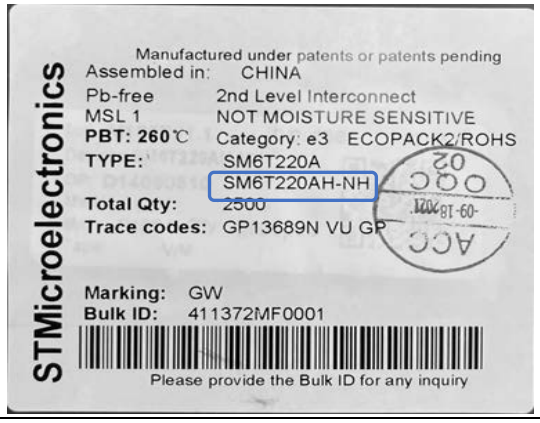
Delivery of the current product version will continue until the stock last.

(1) ADG: Automotive and Discrete Group

Marking and traceability

Traceability of the change will be ensured by Finished Good/Type print on carton labels.

Commercial part number/Order code	Former Finished Good/Type	New Finished Good/Type
SM6T220A	**SM6T220AH/NH**	**SM6T220AH-NH**

Former Label	New Label
Finished Good/Type: **SM6T220AH/NH**	Finished Good/Type: **SM6T220AH-NH**
	

Qualification completion date	Week 04-2022

Forecasted sample availability

Product family	Sub-family	Commercial part Number	Availability date
Protection	Transil	SM6T220A	Available

For sample(s) request, please inform FSE (Field Sales Engineer) to insert corresponding **Non-Standard Samples Order** with **PCN reference** into remarks of order.

Sales type	Estimated production start	Estimated first shipments
SM6T220A	**Apr-2022**	**May-2022**

Comments:	

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	22004QRP Attached

Qualification Report

SM6T220A TVS die dimension rationalization

General Information	
Product Line	*Protection*
Product Description	*600 W 188V TVS in SMB*
Product Perimeter	*SM6T220A*
Product Group	*ADG*
Product Division	*Discrete & Filter*
Packages	*SMB*
Maturity level step	*QUALIFIED*

Locations	
Wafer Fab	*ST TOURS FRANCE*
Assembly Plant	*SUBCONTRACTOR IN CHINA 9941*
Reliability Lab	*ST TOURS – FRANCE*
Reliability Assessment	*PASS*

DOCUMENT INFORMATION

Version	Date	Pages	Prepared by	Approved by	Comments
1.0	21-Jan-2022	12	Aude DROMEL	Julien MICHELON	Initial release

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
MIL-STD-750C	Test method for semiconductor devices

2 GLOSSARY

AC	Autoclave
ESD	Electro-Static Discharge
EV	External Visual
GD	Generic Data
H3TRB	High Humidity High Temperature Reverse Bias
HTRB	High Temperature Reverse Bias
MSL	Moisture Sensitivity Level
PC	Preconditioning
PV	Parametric Verification
SS	Sample Size
TC	Temperature Cycling

3 RELIABILITY EVALUATION OVERVIEW

3.1 Objectives

The objective of this report is the die rationalization of SM6T220A, 600 W TVS embedded in SMB package.

The reliability test methodology used follows the JESD47: « Stress Test driven Qualification Methodology ».

The reliability tests ensuing are:

- TC 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.
- H3TRB to check the robustness to corrosion and the good package hermeticity.

For some tests, similarity methodology is used. See 5.1 “comments” for more details about similarities.

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

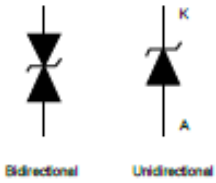
4.1 Device description

life.augmented

SM6T

Datasheet

600 W TVS in SMB



Features

- Peak pulse power: 600 W (10/1000 µs) and 4 kW (8/20 µs)
- Stand-off voltage range from 5 V to 188 V
- Unidirectional and bidirectional types
- Low leakage current: 0.2 µA at 25 °C and 1 µA at 85 °C
- Operating T_j max: 150 °C
- High power capability at T_j max.: up to 515 W (10/1000 µs)
- Lead finishing: matte tin plating

Complies with the following standards

- UL94, V0
- J-STD-020 MSL level 1
- J-STD-002, JESD 22-B102 E3 and MIL-STD-750, method 2026 solderable matte tin plated leads
- JESD-201 class 2 whisker test
- IPC7531 footprint
- JEDEC registered package outline
- IEC 61000-4-4 level 4:
  - 4 kV
- IEC 61000-4-2, C = 150 pF - R = 330 Ω exceeds level 4:
  - 30 kV (air discharge)
  - 30 kV (contact discharge)

Product status link	
SM6T	SM6T6V8A, SM6T6V8CA, SM6T7V5A, SM6T7V5CA, SM6T10A, SM6T10CA, SM6T12A, SM6T12CA, SM6T15A, SM6T15CA, SM6T18A, SM6T18CA, SM6T22A, SM6T22CA, SM6T24A, SM6T24CA, SM6T27A, SM6T27CA, SM6T30A, SM6T30CA, SM6T33A, SM6T33CA, SM6T36A, SM6T36CA, SM6T39A, SM6T39CA, SM6T56A, SM6T56CA, SM6T68A, SM6T68CA, SM6T75A, SM6T75CA, SM6T100A, SM6T100CA, SM6T150A, SM6T150CA, SM6T200A, SM6T200CA, SM6T220A, SM6T220CA

Description

The SM6T series are designed to protect sensitive equipment against electrostatic discharges according to IEC 61000-4-2 and MIL STD 883, method 3015, and electrical overstress according to IEC 61000-4-4 and 5. This device is more generally used against surges below 600 W (10/1000 µs).

The Planar technology makes it suitable for high-end equipment and SMPS where low leakage current and high junction temperature are required to provide reliability and stability over time.

The SM6T series are packaged in SMB.

4.2 Construction Note

	SM6T220A
Wafer/Die fab. information	
Wafer fab manufacturing location	ST TOURS FRANCE
Technology / Process family	DISCRETE-TRANSIL / TAN
Wafer Testing (EWS) information	
Electrical testing manufacturing location	ST TOURS FRANCE
Assembly information	
Assembly site	SUBCONTRACTOR IN CHINA
Package description	SMB
Molding compound	ECOPACK®2 molding compound
Lead finishing material	Lead free
Final testing information	
Testing location	SUBCONTRACTOR IN CHINA

5 TESTS PLAN AND RESULTS SUMMARY

5.1 Test vehicles

Lot #	Part Number	Package	Wafer fab location	Assy plant Location	Comments
Lot1	SM6T220A	SMB	TOURS	Subcontractor in China	Qualification lot
GD1	SM6T200CA	SMB	TOURS	Subcontractor in China	Same die technology, same die size. Different voltage
GD2	SM6T250CAY	SMB	TOURS	Subcontractor in China	Same die technology, bigger die size. Higher voltage
GD3	SMAJ188CA	SMA	TOURS	Subcontractor in China	Same die technology, smaller die size. Same voltage

GD: Test vehicles used for similarity.

Detailed results in below chapter will refer to these references.

5.2 Test plan

Stress	Abrv	Reference	Lot	SS	Comments	Test plan
Pre and Post-Stress Electrical Test	TEST	User specification or supplier's standard Specification	All qualification parts tested per the requirements of the appropriate device specification.			X
Pre-conditioning	PC	J-STD-020 JESD22-A113	All qualification parts tested per the requirements of the appropriate device specification.		As per targeted MSL Not applicable for PTH and WLCSP without coating	X
MSL research	MSL	J-STD-020			Covered by initial product qualification	
External Visual	EV	JESD22B-101	All qualification parts tested per the requirements of the appropriate device specification.		Done during Assembly → Test & Finish inspection	X
Parametric Verification	PV	User specification	L1	30		X
High Temperature Reverse Bias	HTRB	MIL-STD-750-1 M1038 Method A (for diodes, rectifiers and Zeners) M1039 Method A (for transistors)	L1, GD2, GD3	3x77	WBI after HTRB applicable only for dissimilar metal (wire/meta) in case of no Cu wire	X
AC blocking voltage	ACBV	MIL-STD-750-1 M1040 Test condition A			Required for Thyristor only. Alternative to HTRB	
High Temperature Forward Bias	HTFB	JESD22 A-108			Not required, applicable only to LEDS Alternative to HTRB	
High Temperature Operating Life	HTOL				Covered by HTRB or ACBV	
Steady State Operational	SSOP	MIL-STD-750-1 M1038 Test condition B			Required for Voltage Regulator (Zener) only.	
High Temperature Gate Bias	HTGB	JESD 22A-108			Required for PowerMOSFET – IGBT only.	
High Temperature Storage Life	HTSL	JESD22 A-103			Covered by HTRB	
Temperature Humidity Storage	THS	JESD22 A-118			Covered by H3TRB	
Temperature Cycling	TC	JESD22A-104	L1, GD1, GD2	4x77		X
Temperature Cycling Hot Test	TCHT	JESD22A-104			Required for PowerMOSFET – IGBT only.	
Temperature Cycling Delamination Test	TCDT	JESD22A-104 J-STD-035			Required for PowerMOSFET – IGBT only. Alternative to TCHT	
Wire Bond Integrity	WBI	MIL-STD-750 Method 2037			For dissimilar metal bonding systems only	

Stress	Abrv	Reference	Lot	SS	Comments	Test plan
Unbiased Highly Accelerated Stress Test	UHAST	JESD22A-118 or A101			Covered by H3TRB	
Autoclave	AC	JESD22A-102			Covered by H3TRB	
Highly Accelerated Stress Test	HAST	JESD22A-110			Covered by H3TRB (same failure mechanisms activation).	
High Humidity High Temperature Reverse Bias	H3TRB	JESD22A-101	L1, GD3	2x77	Alternative to HAST	X
High Temperature High Humidity Bias	HTHHB	JED22A-101			Not required, LED only	
Intermittent Operational Life / Thermal Fatigue	IOL	MIL-STD-750 Method 1037			For power devices. Not required for Transient Voltage Suppressor (TVS) parts	
Power and Temperature Cycle	PTC	JED22A-105			For power devices. Not required for Transient Voltage Suppressor (TVS) parts Perform PTC if $\Delta Tj>100°C$ cannot be achieved with IOL Alternative to IOL	
ESD Characterization	ESD HBM	AEC Q101-001 and 005			For automotive qualification	
ESD Characterization	ESD CDM	AEC Q101-001 and 005			For automotive qualification	
Destructive Physical Analysis	DPA	AEC-Q101-004 Section 4			After H3TRB and TC For automotive qualification	
Physical Dimension	PD	JESD22B-100			No change concerning package	
Terminal Strength	TS	MIL-STD-750 Method 2036			Required for leaded parts only	
Resistance to Solvents	RTS	JESD22B-107			Not applicable for Laser Marking	
Constant Acceleration	CA	MIL-STD-750 Method 2006			Required for hermetic packaged parts only.	
Vibration Variable Frequency	VVF	JESD22B-103			Required for hermetic packaged parts only.	
Mechanical Shock	MS	JESD22 B-104			Required for hermetic packaged parts only.	
Hermeticity	HER	JESD22A-109			Required for hermetic packaged parts only.	
Resistance to Solder Heat	RSH	JESD22 A-111 (SMD) B-106 (PTH)			Not applicable for SMD pitch < 0.5mm, package size > 5.5*12.5mm and die paddle > 2.5*3.5mm	
Solderability	SD	J-STD-002 JESD22B102			No change concerning package	
Dead Bug Test	DBT	ST Internal specification			Mandatory for SMD package No change concerning package	
Thermal Resistance	TR	JESD24-3, 24-4, 24-6 as appropriate			Not applicable to protection device as no limit specified in the datasheet	
Wire Bond Strength	WBS	MIL-STD-750 Method 2037			No wire bonding	
Bond Shear	BS	AEC-Q101-003			No wire bonding	

Stress	Abrv	Reference	Lot	SS	Comments	Test plan
Die Shear	DS	MIL-STD-750 Method 2017			Not Applicable to parts with solder paste die attach	
Unclamped Inductive Switching	UIS	AEC-Q101-004 section 2			Required for Power MOS and internally clamped IGBTs only	
Dielectric Integrity	DI	AEC-Q101-004 section 3			Required for PowerMOSFET - IGBT only.	
Short Circuit Reliability Characterization	SCR	AEC-Q101-006			Required for smart power parts only	
Whisker Growth Evaluation	WG	AEC-Q005 JESD201			No change concerning package	
Early Life Failure Rate	ELFR	JESD74			Recommended for new techno development in case of identified failure mechanism	
Functional Test (in rush, di/dt,...)	FT	Internal specification				
Repetitive Surge	RS	Internal specification	L1, GD1, GD2, GD3	4x20	Required for protection devices only.	X

Low Temperature Storage	LTS	JESD-22 A119: 209	Lx or GDx	xx	AQG324 test for Modules	X
Thermal shock test	TST	JESD22-A104	Lx or GDx	xx	AQG324 test for Modules	X
Power Cycling (seconds)	PCsec	MIL-STD750-1 Method1037	Lx or GDx	xx	AQG324 test for Modules	X
Power Cycling (minutes)	PCmin	MIL-STD750-1 Method1037	Lx or GDx	xx	AQG324 test for Modules	X
Mechanical shock	MS	IEC 600068-2-27	Lx or GDx	xx	AQG324 test for Modules	X
Vibration	V	IEC60068-2-6	Lx or GDx	xx	AQG324 test for Modules	X

5.3 Results summary

Test	PC	Std ref.	Conditions	Steps / Duration	SS	Failure/SS			
						L1	GD1	GD2	GD3
Pre- and Post-Electrical Test		ST datasheet	Ir, VBR,parameters following product datasheet	-		0/696			
PC (for SMD packages)		JESD22 A-113	Drying 24hrs; 125°C Storage 168hrs; 85°C;85%RH IR reflow 3 times	-	465	0/174	0/97	0/97	0/97
External Visual		JESD22 B-101	All qualification parts submitted for testing passed External & Visual inspection during manufacturing process						
Parametric Verification		ST datasheet	Over part temperature range (note 1)		30	Refer to paragraph 6.1 in Annexes			
HTRB	N	MIL-STD-750-1 M1038 Method A	Tj=150°C VR=100% VRM	1Khrs	231 (3x77)	0/77		0/77	0/77
TC	Y	JESD22 A-104	-55/+150°C 2cy/h	500cy	231 (3x77)	0/77	0/77	0/77	
H3TRB (Alt to HAST)	Y	JESD22 A-101	85°C; 85% RH VR=100V	1Khrs	154 (2x77)	0/77			0/77
Functional Tests									
RS	Y	0060282 (ST internal)	IPP 10/1000 at IPP datasheet (A/µs)	50surges	80 (4x20)	0/20	0/20	0/20	0/20

Note 1: These data are indicative values given as information only. Please note that the ST guarantee is the compliance of the products to the ST datasheet. Parameters distributions are not considered as a ST guarantee under any circumstances.
Please note that these electrical parameters are 100% tested at 25°C at Final stage of back-end manufacturing before deliveries to customers."

6 ANNEXES

6.1 Parametric Verification

Paramètres	Data sheet			SM6T220A Lot1
	Min	Max		
IR (µA) @ VRM=188V Tj=25°C	-	0.2	Med (µA)	0.0003
VBR (V) @ IR=1mA	209	231	Med	219.200
VCL (V) @ IPP= 2A 10/1000us	-	328	Med	276.70
RD (Ohm) 10/1000us	-	48.5	Med (µA)	25.10
IPP dest (A) 10/1000us	2	-	Min	2.69
			Med	2.80
PPP (W) 10/1000us	600	-	Min	782
			Med	818
VCL (V) @ IPP= 10.3A 8/20us	-	388	Med	289
RD (Ohm) 8/20us	-	15.2	Med (µA)	5.39
IPP dest (A) 8/20us	10.3	-	Min	19.40
			Med	21.70
PPP (W) 8/20us	4000	-	Min	6440
			Med	7195

6.2 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. Forward: device is forward biased with a current fixed and adjusted to reach the 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. To assess active area and contacts integrity
Package Oriented		
PC Preconditioning	The device is submitted to a typical temperature profile used for surface mounting devices, after a controlled moisture absorption.	As stand-alone test: to investigate the moisture sensitivity level. As preconditioning before other reliability tests: to verify that the surface mounting stress does not impact on the subsequent reliability performance. The typical failure modes are "pop-corn" effect and delamination.
H3TRB 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.
Functional Tests		
RS Repetitive Surges	The device is submitted to a reverse current peak: Ipp, which depends of the current holding of the product.	To evaluate the holding of the component to a high electrical field. Short circuit or hot point is expected as failure mechanism.

Qualification Report

SM6T220A TVS die dimension rationalization

General Information	
Product Line	*Protection*
Product Description	*600 W 188V TVS in SMB*
Product Perimeter	*SM6T220A*
Product Group	*ADG*
Product Division	*Discrete & Filter*
Packages	*SMB*
Maturity level step	*QUALIFIED*

Locations	
Wafer Fab	*ST TOURS FRANCE*
Assembly Plant	*SUBCONTRACTOR IN CHINA 9941*
Reliability Lab	*ST TOURS – FRANCE*
Reliability Assessment	*PASS*

DOCUMENT INFORMATION

Version	Date	Pages	Prepared by	Approved by	Comments
1.0	21-Jan-2022	12	Aude DROMEL	Julien MICHELON	Initial release

TABLE OF CONTENTS

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JESD 94	Application specific qualification using knowledge based test methodology
JESD 22	Reliability test methods for packaged devices
MIL-STD-750C	Test method for semiconductor devices

2 GLOSSARY

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H3TRB	High Humidity High Temperature Reverse Bias
HTRB	High Temperature Reverse Bias
MSL	Moisture Sensitivity Level
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PV	Parametric Verification
SS	Sample Size
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3 RELIABILITY EVALUATION OVERVIEW

3.1 Objectives

The objective of this report is the die rationalization of SM6T220A, 600 W TVS embedded in SMB package.

The reliability test methodology used follows the JESD47: « Stress Test driven Qualification Methodology ».

The reliability tests ensuing are:

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For some tests, similarity methodology is used. See 5.1 “comments” for more details about similarities.

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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

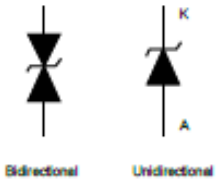
4.1 Device description

life.augmented

SM6T

Datasheet

600 W TVS in SMB



Features

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- Stand-off voltage range from 5 V to 188 V
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- Low leakage current: 0.2 µA at 25 °C and 1 µA at 85 °C
- Operating T_j max: 150 °C
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- Lead finishing: matte tin plating

Complies with the following standards

- UL94, V0
- J-STD-020 MSL level 1
- J-STD-002, JESD 22-B102 E3 and MIL-STD-750, method 2026 solderable matte tin plated leads
- JESD-201 class 2 whisker test
- IPC7531 footprint
- JEDEC registered package outline
- IEC 61000-4-4 level 4:
  - 4 kV
- IEC 61000-4-2, C = 150 pF - R = 330 Ω exceeds level 4:
  - 30 kV (air discharge)
  - 30 kV (contact discharge)

Product status link	
SM6T	SM6T6V8A, SM6T6V8CA, SM6T7V5A, SM6T7V5CA, SM6T10A, SM6T10CA, SM6T12A, SM6T12CA, SM6T15A, SM6T15CA, SM6T18A, SM6T18CA, SM6T22A, SM6T22CA, SM6T24A, SM6T24CA, SM6T27A, SM6T27CA, SM6T30A, SM6T30CA, SM6T33A, SM6T33CA, SM6T36A, SM6T36CA, SM6T39A, SM6T39CA, SM6T56A, SM6T56CA, SM6T68A, SM6T68CA, SM6T75A, SM6T75CA, SM6T100A, SM6T100CA, SM6T150A, SM6T150CA, SM6T200A, SM6T200CA, SM6T220A, SM6T220CA

Description

The SM6T series are designed to protect sensitive equipment against electrostatic discharges according to IEC 61000-4-2 and MIL STD 883, method 3015, and electrical overstress according to IEC 61000-4-4 and 5. This device is more generally used against surges below 600 W (10/1000 µs).

The Planar technology makes it suitable for high-end equipment and SMPS where low leakage current and high junction temperature are required to provide reliability and stability over time.

The SM6T series are packaged in SMB.

4.2 Construction Note

	SM6T220A
Wafer/Die fab. information	
Wafer fab manufacturing location	ST TOURS FRANCE
Technology / Process family	DISCRETE-TRANSIL / TAN
Wafer Testing (EWS) information	
Electrical testing manufacturing location	ST TOURS FRANCE
Assembly information	
Assembly site	SUBCONTRACTOR IN CHINA
Package description	SMB
Molding compound	ECOPACK®2 molding compound
Lead finishing material	Lead free
Final testing information	
Testing location	SUBCONTRACTOR IN CHINA

5 TESTS PLAN AND RESULTS SUMMARY

5.1 Test vehicles

Lot #	Part Number	Package	Wafer fab location	Assy plant Location	Comments
Lot1	SM6T220A	SMB	TOURS	Subcontractor in China	Qualification lot
GD1	SM6T200CA	SMB	TOURS	Subcontractor in China	Same die technology, same die size. Different voltage
GD2	SM6T250CAY	SMB	TOURS	Subcontractor in China	Same die technology, bigger die size. Higher voltage
GD3	SMAJ188CA	SMA	TOURS	Subcontractor in China	Same die technology, smaller die size. Same voltage

GD: Test vehicles used for similarity.

Detailed results in below chapter will refer to these references.

5.2 Test plan

Stress	Abrv	Reference	Lot	SS	Comments	Test plan
Pre and Post-Stress Electrical Test	TEST	User specification or supplier's standard Specification	All qualification parts tested per the requirements of the appropriate device specification.			X
Pre-conditioning	PC	J-STD-020 JESD22-A113	All qualification parts tested per the requirements of the appropriate device specification.		As per targeted MSL Not applicable for PTH and WLCSP without coating	X
MSL research	MSL	J-STD-020			Covered by initial product qualification	
External Visual	EV	JESD22B-101	All qualification parts tested per the requirements of the appropriate device specification.		Done during Assembly → Test & Finish inspection	X
Parametric Verification	PV	User specification	L1	30		X
High Temperature Reverse Bias	HTRB	MIL-STD-750-1 M1038 Method A (for diodes, rectifiers and Zeners) M1039 Method A (for transistors)	L1, GD2, GD3	3x77	WBI after HTRB applicable only for dissimilar metal (wire/meta) in case of no Cu wire	X
AC blocking voltage	ACBV	MIL-STD-750-1 M1040 Test condition A			Required for Thyristor only. Alternative to HTRB	
High Temperature Forward Bias	HTFB	JESD22 A-108			Not required, applicable only to LEDS Alternative to HTRB	
High Temperature Operating Life	HTOL				Covered by HTRB or ACBV	
Steady State Operational	SSOP	MIL-STD-750-1 M1038 Test condition B			Required for Voltage Regulator (Zener) only.	
High Temperature Gate Bias	HTGB	JESD 22A-108			Required for PowerMOSFET – IGBT only.	
High Temperature Storage Life	HTSL	JESD22 A-103			Covered by HTRB	
Temperature Humidity Storage	THS	JESD22 A-118			Covered by H3TRB	
Temperature Cycling	TC	JESD22A-104	L1, GD1, GD2	4x77		X
Temperature Cycling Hot Test	TCHT	JESD22A-104			Required for PowerMOSFET – IGBT only.	
Temperature Cycling Delamination Test	TCDT	JESD22A-104 J-STD-035			Required for PowerMOSFET – IGBT only. Alternative to TCHT	
Wire Bond Integrity	WBI	MIL-STD-750 Method 2037			For dissimilar metal bonding systems only	

Stress	Abrv	Reference	Lot	SS	Comments	Test plan
Unbiased Highly Accelerated Stress Test	UHAST	JESD22A-118 or A101			Covered by H3TRB	
Autoclave	AC	JESD22A-102			Covered by H3TRB	
Highly Accelerated Stress Test	HAST	JESD22A-110			Covered by H3TRB (same failure mechanisms activation).	
High Humidity High Temperature Reverse Bias	H3TRB	JESD22A-101	L1, GD3	2x77	Alternative to HAST	X
High Temperature High Humidity Bias	HTHHB	JED22A-101			Not required, LED only	
Intermittent Operational Life / Thermal Fatigue	IOL	MIL-STD-750 Method 1037			For power devices. Not required for Transient Voltage Suppressor (TVS) parts	
Power and Temperature Cycle	PTC	JED22A-105			For power devices. Not required for Transient Voltage Suppressor (TVS) parts Perform PTC if $\Delta Tj>100°C$ cannot be achieved with IOL Alternative to IOL	
ESD Characterization	ESD HBM	AEC Q101-001 and 005			For automotive qualification	
ESD Characterization	ESD CDM	AEC Q101-001 and 005			For automotive qualification	
Destructive Physical Analysis	DPA	AEC-Q101-004 Section 4			After H3TRB and TC For automotive qualification	
Physical Dimension	PD	JESD22B-100			No change concerning package	
Terminal Strength	TS	MIL-STD-750 Method 2036			Required for leaded parts only	
Resistance to Solvents	RTS	JESD22B-107			Not applicable for Laser Marking	
Constant Acceleration	CA	MIL-STD-750 Method 2006			Required for hermetic packaged parts only.	
Vibration Variable Frequency	VVF	JESD22B-103			Required for hermetic packaged parts only.	
Mechanical Shock	MS	JESD22 B-104			Required for hermetic packaged parts only.	
Hermeticity	HER	JESD22A-109			Required for hermetic packaged parts only.	
Resistance to Solder Heat	RSH	JESD22 A-111 (SMD) B-106 (PTH)			Not applicable for SMD pitch < 0.5mm, package size > 5.5*12.5mm and die paddle > 2.5*3.5mm	
Solderability	SD	J-STD-002 JESD22B102			No change concerning package	
Dead Bug Test	DBT	ST Internal specification			Mandatory for SMD package No change concerning package	
Thermal Resistance	TR	JESD24-3, 24-4, 24-6 as appropriate			Not applicable to protection device as no limit specified in the datasheet	
Wire Bond Strength	WBS	MIL-STD-750 Method 2037			No wire bonding	
Bond Shear	BS	AEC-Q101-003			No wire bonding	

Stress	Abrv	Reference	Lot	SS	Comments	Test plan
Die Shear	DS	MIL-STD-750 Method 2017			Not Applicable to parts with solder paste die attach	
Unclamped Inductive Switching	UIS	AEC-Q101-004 section 2			Required for Power MOS and internally clamped IGBTs only	
Dielectric Integrity	DI	AEC-Q101-004 section 3			Required for PowerMOSFET - IGBT only.	
Short Circuit Reliability Characterization	SCR	AEC-Q101-006			Required for smart power parts only	
Whisker Growth Evaluation	WG	AEC-Q005 JESD201			No change concerning package	
Early Life Failure Rate	ELFR	JESD74			Recommended for new techno development in case of identified failure mechanism	
Functional Test (in rush, di/dt,...)	FT	Internal specification				
Repetitive Surge	RS	Internal specification	L1, GD1, GD2, GD3	4x20	Required for protection devices only.	X

Low Temperature Storage	LTS	JESD-22 A119: 209	Lx or GDx	xx	AQG324 test for Modules	X
Thermal shock test	TST	JESD22-A104	Lx or GDx	xx	AQG324 test for Modules	X
Power Cycling (seconds)	PCsec	MIL-STD750-1 Method1037	Lx or GDx	xx	AQG324 test for Modules	X
Power Cycling (minutes)	PCmin	MIL-STD750-1 Method1037	Lx or GDx	xx	AQG324 test for Modules	X
Mechanical shock	MS	IEC 600068-2-27	Lx or GDx	xx	AQG324 test for Modules	X
Vibration	V	IEC60068-2-6	Lx or GDx	xx	AQG324 test for Modules	X

5.3 Results summary

Test	PC	Std ref.	Conditions	Steps / Duration	SS	Failure/SS			
						L1	GD1	GD2	GD3
Pre- and Post-Electrical Test		ST datasheet	Ir, VBR,parameters following product datasheet	-		0/696			
PC (for SMD packages)		JESD22 A-113	Drying 24hrs; 125°C Storage 168hrs; 85°C;85%RH IR reflow 3 times	-	465	0/174	0/97	0/97	0/97
External Visual		JESD22 B-101	All qualification parts submitted for testing passed External & Visual inspection during manufacturing process						
Parametric Verification		ST datasheet	Over part temperature range (note 1)		30	Refer to paragraph 6.1 in Annexes			
HTRB	N	MIL-STD-750-1 M1038 Method A	Tj=150°C VR=100% VRM	1Khrs	231 (3x77)	0/77		0/77	0/77
TC	Y	JESD22 A-104	-55/+150°C 2cy/h	500cy	231 (3x77)	0/77	0/77	0/77	
H3TRB (Alt to HAST)	Y	JESD22 A-101	85°C; 85% RH VR=100V	1Khrs	154 (2x77)	0/77			0/77
Functional Tests									
RS	Y	0060282 (ST internal)	IPP 10/1000 at IPP datasheet (A/µs)	50surges	80 (4x20)	0/20	0/20	0/20	0/20

Note 1: These data are indicative values given as information only. Please note that the ST guarantee is the compliance of the products to the ST datasheet. Parameters distributions are not considered as a ST guarantee under any circumstances.
Please note that these electrical parameters are 100% tested at 25°C at Final stage of back-end manufacturing before deliveries to customers."

6 ANNEXES

6.1 Parametric Verification

Paramètres	Data sheet			SM6T220A Lot1
	Min	Max		
IR (µA) @ VRM=188V Tj=25°C	-	0.2	Med (µA)	0.0003
VBR (V) @ IR=1mA	209	231	Med	219.200
VCL (V) @ IPP= 2A 10/1000us	-	328	Med	276.70
RD (Ohm) 10/1000us	-	48.5	Med (µA)	25.10
IPP dest (A) 10/1000us	2	-	Min	2.69
			Med	2.80
PPP (W) 10/1000us	600	-	Min	782
			Med	818
VCL (V) @ IPP= 10.3A 8/20us	-	388	Med	289
RD (Ohm) 8/20us	-	15.2	Med (µA)	5.39
IPP dest (A) 8/20us	10.3	-	Min	19.40
			Med	21.70
PPP (W) 8/20us	4000	-	Min	6440
			Med	7195

6.2 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. Forward: device is forward biased with a current fixed and adjusted to reach the 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. To assess active area and contacts integrity
Package Oriented		
PC Preconditioning	The device is submitted to a typical temperature profile used for surface mounting devices, after a controlled moisture absorption.	As stand-alone test: to investigate the moisture sensitivity level. As preconditioning before other reliability tests: to verify that the surface mounting stress does not impact on the subsequent reliability performance. The typical failure modes are "pop-corn" effect and delamination.
H3TRB 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.
Functional Tests		
RS Repetitive Surges	The device is submitted to a reverse current peak: Ipp, which depends of the current holding of the product.	To evaluate the holding of the component to a high electrical field. Short circuit or hot point is expected as failure mechanism.