PRODUCT / PROCESS CHANGE NOTIFICATION

1. PCN basic data	
1.1 Company	STMicroelectronics International N.V
1.2 PCN No.	ADG/19/11892
1.3 Title of PCN	VIPower Products (TO-220): New Mold Compound Introduction (Hysol GR30)
1.4 Product Category	See list
1.5 Issue date	2019-12-18

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	Mario ASTUTI,Nicola LIPORACE
2.1.2 Marketing Manager	Stello Matteo BILLE'
2.1.3 Quality Manager	Francesco MINERVA

3. Change		
3.1 Category	3.2 Type of change	3.3 Manufacturing Location
Materials	New direct material part number (same supplier, different supplier or new supplier), Mold compound	ST Shenzhen (China)

4. Description of change		
	Old	New
4.1 Description	Molding compound Samsung SI-7200DXC	Molding compound Loctite Hysol GR30
4.2 Anticipated Impact on form,fit, function, quality, reliability or processability?	No Impct	

5. Reason / motivation for change	
5.1 Motivation	Discontinuation of current Samsung Mold Compound. Following PCI CRP/19/11478
5.2 Customer Benefit	SERVICE CONTINUITY

6. Marking of parts / traceability of change	
6.1 Description	Dedicated Finished Good Codes

7. Timing / schedule	
7.1 Date of qualification results	2019-12-04
7.2 Intended start of delivery	2020-02-28
7.3 Qualification sample available?	Upon Request

8. Qualification / Validation			
8.1 Description	11892 Validation.pdf		
8.2 Qualification report and qualification results	Available (see attachment)	Issue Date	2019-12-18

9. Attachments (additional documentations)

11892 Public product.pdf
11892 Validation.pdf
11892 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
	VNP10N07-E	
	VNP14NV04-E	
	VNP20N07-E	
	VNP35N07-E	
	VNP35NV04-E	
	VNP5N07-E	

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PRODUCT/PROCESS CHANGE NOTIFICATION

SUBJECT	**VIPower Products (TO-220): New Molding Compound Introduction (HYSOL GR30)**
IMPACTED PRODUCTS	Below VIPower products housed in TO-220 package

Line	Commercial Product
VN78	VNP14NV04-E
VN76	VNP35NV04-E
VN58	VN1160T-E
VN49	VNP5N07-E
VN39	VNP10N07-E
VN29	VNP20N07-E
VN19	VNP35N07-E
VN28	VNP10N06-E

MANUFACTURING STEP	Assembly
INVOLVED PLANT	ST Shenzhen (China)
CHANGE REASON	Service Continuity
CHANGE DESCRIPTION	Following communication CRP/19/11478 about discontinuation of current molding compounds Samsung SDI for Though Hole packages. Please be informed that on VIPower products housed in TO-220, current molding compound Samsung SI-7200DXC will be replaced by Loctite Hysol GR30
TRACEABILITY	Dedicated Finished Goods Codes
VALIDATION	Validation results enclosed in this communication 11892 Validation.pdf
SAMPLES	Available on demand
IMPLEMENTATION	We are ready to implement the change upon Customer agreement

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 : VIPower Products (TO-220): New Mold Compound Introduction (Hysol GR30)

PCN Reference : ADG/19/11892

Subject : Public Products List

Dear Customer,

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

VNP35N07-E	VNP20N07-E	VNP35NV04-E
VNP5N07-E	VNP10N07-E	

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ST Shenzhen
TO220 package
New Molding Compound

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Outline

Change Description

- This documentation follow the Samsung SDI production discontinuation announcement shared by ST Corporate Advance Notification PCI CRP/19/11478, sent in April 2019;
- In order to qualify the new molding compound supplier for devices designed in VIPower assembled in TO220 package and manufactured in ST Shenzhen (China) assembly plant, a qualification activity has been performed on selected products chosen as test vehicles;
- This report show the positive results achieved by converting the molding compound from Samsung SDI to Loctite Hysol GR30 (new material code available on BOM) without modifying the current assembly process flow and ensuring the same quality and electrical characteristics of the test vehicle assembled in TO220 package.

TO220 package new molding compound

ZVEI Guidelines

- According to ZVEI recommendations, the notification is required.

		Assessment of impact on Supply Chain regarding following aspects - contractual agreements - technical interface of processability/manufacturability of customer - form, fit, function, quality performance, reliability	Remaining risks on Supply Chain?		Understanding of semiconductors experts	Examples to explain
	ID	Type of change	No	Yes		
		ANY				
		DATA SHEET				
		DESIGN				
		PROCESS - WAFER PRODUCTION				
		BARE DIE				
		PROCESS - ASSEMBLY				
x	SEM-PA-11	Change of mold compound / encapsulation material	P	P	Change of mold compound / encapsulation material.	e.g. change to green mold compound e.g. change of filler particles

Extract from ZVEI

Selected Test Vehicles

1. VIPower M0A2 Technology
   i. TO-220: **VNP35N07-E** (Silicon Line **VN19**)
   ii. TO-220: **VNP20N07-E** (Silicon Line **VN29**)

2. VIPower M0A3 Technology
   i. TO-220: **VN1160T-E** (Silicon Line **VN58**)

Reliability Evaluation Report
Package TO220
New Molding Compound Supplier
VIPower M02 and M03

General Information	
Commercial Product :	VNP35N07, VNP20N07, VN1160T
Product Line :	VN19, VN29, VN58
Package :	TO220
Silicon Technology :	VIPower-M02, VIPower-M03

Note: *this report is a summary of the reliability trials performed in good faith by STMicroelectronics in order to evaluate the electronic device conformance to its specific mission profile for Automotive Application. This report and its contents shall not be disclosed to a third party without previous written agreement from STMicroelectronics or under the approval of the author (see below).*

Revision history

Rev.	Changes description	Author	Date
A	Initial Release (Preliminary)	A. Vilardo	11/12/2019

Approved by

Function	Location	Name	Date
Division Reliability Manager	ST Catania (Italy)	A. Marmoni	11/12/2019

TABLE OF CONTENTS

1 RELIABILITY EVALUATION OVERVIEW

1.1 Objective

In order to qualify a new molding compound supplier for devices designed in VIPower M02 and M03 Technologies assembled in TO220 package in ST Shenzhen (China) assembly plant, a reliability job has been performed according to **AEC_Q100 Rev.H** specification on selected devices chosen as test vehicles having maximum die size per each involved families:

Test vehicles general information			
Commercial Product	VNP35N07-E	VNP20N07-E	VN1160T-E
Product Line	VN19	VN29	VN58
Technology	VIPower M02	VIPower M02	VIPower M03

Aim of this report is to present the results of the reliability evaluations performed on these test vehicles comparing the present molding compound Samsung SI-7200DXC with the new one Hysol GR30.

The involved products are OMNIFET fully auto-protected Power MOSFET (VNB35N07-E and VNB20N07-E) designed in VIPower M02 Technology and a monolithic device designed in VIPower M03 technology intended for building a complete flashing unit (VN1160T-E). All products are diffused in ST SG6 Ang Mo Kio (Singapore) 6" Wafer Fab.

1.2 Reliability Strategy and Test Plan

1.2.1 Reliability strategy

Reliability trials performed as part of this reliability evaluation are in agreement with ST 0061692 and **AEC Q100 rev. H Grade 1** specification and are listed in below Test Plan. For details on test conditions, generic data used and specifications references refer to test results summary in section 3.

1.2.2 Test Plan

AEC-Q100 TEST PLAN

TEST GROUP	TEST NAME	DESCRIPTION / COMMENTS	TEST FLAG
A Accelerated Environment Stress Tests	PC (JL3)	Preconditioning (JL3+3 reflows simulation)	Not Applicable
	THB	Temperature Humidity Bias	Yes
	AC	Autoclave at 2atm	Yes
	TC	Temperature Cycling	Yes
	PTC	Power Temperature Cycling	Yes
	HTSL	High Temperature Storage Life	Yes
B Accelerated Lifetime Simulation Tests	HTOL	High Temperature Operating Life	Yes
	ELFR	Early Life Failure Rate	Yes
	EDR	Endurance Data Retention	Not Applicable
C Package Assembly Integrity Tests	WBS	Wire Bond Shear	Yes
	WBP	Wire Bond Pull	Yes
	SD	Solderability	Yes
	PD	Physical Dimension	Yes
	SBS	Solder Ball Shear	Not Applicable
	LI	Lead Integrity	Not Applicable
D Die Fabrication Reliability Tests	Test list is reported in section 5	Performed during process qualification	Not Applicable
E Electrical Verification Tests	ESD (HBM)	Electrostatic Discharge (Human Body Model)	Not Applicable
	ESD (CDM)	Electrostatic Discharge (Charged Device Model)	Not Applicable
	LU	Latch Up	Not Applicable
	ED	Electrical distribution	Not Applicable
	FG	Fault grading	Not Applicable
	CHAR	Characterization	Not Applicable
	EMC	Electromagnetic Compatibility	Not Applicable
	SC	Short Circuit Characterization	Not Applicable
	SER	Soft Error Rate	Not Applicable
	LF	Lead(Pb) Free: (see AEC-Q005)	Not Applicable
F Defect Screening Tests	Test list is reported in section 5	To be implemented starting from first production lot	No
G Cavity Package Integrity Tests	Test list is reported in section 5	N/A: not for plastic packaged devices	Not Applicable

In the below table a comparison between the AEC-Q100 and ZVEI requirements vs the applied ST qualification plan is reported:

	Test Group A					Test Group B		Test Group C				Test Group D					Test Group E					
	THB	AC	TC	PTC	HTSL	HTOL	ELFR	WBS	WBP	SD	PD	EM	TDDB	HCI	NBTI	SM	HBM	CDM	LU	ED	EMC	SC
AEC-Q100	x	x	x	x	x	x	x			x	x											
ZVEI	x	x	x	x	x	x	x			x	x											
ST	x	x	x	x	x	x	x	x	x	x	x											

1.3 Conclusion

All reliability tests (1x AEC-Q100 requirement) have been completed with positive results. Neither functional nor parametric rejects were detected at the present read out. (Results @500 thermal cycles, see Test Results Summary section)

Wire Bond Pull/Shear tests (WBP, WBS) as Package Assembly Integrity (test Group C) performed before and after the package oriented stress test pointed out neither abnormal break loads nor forbidden failure modes. SAM analysis performed after the package oriented stress test, pointed out no delamination at the Die/Molding Compound, Die-Pad/Molding Compound and Die Attach Material interfaces.

A new reliability report version will be released as soon as the final results will be available.

2. Product Characteristics

2.1. Generalities

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VNP35N07-E, VNB35N07-E, VNV35N07-E

OMNIFET: fully autoprotected Power MOSFET

Datasheet – production data

TO-220 D2PAK PowerSO-10

Features

Type	V_{clamp}	$R_{DS(on)}$	I_{lim}
VNP35N07-E	70 V	0.028 Ω	35 A
VNB35N07-E	70 V	0.028 Ω	35 A
VNV35N07-E	70 V	0.028 Ω	35 A

- Automotive qualified
- Linear current limitation
- Thermal shutdown
- Short circuit protection
- Integrated clamp
- Low current drawn from input pin
- Diagnostic feedback through input pin
- ESD protection
- Direct access to the gate of the Power MOSFET (analog driving)
- Compatible with standard Power MOSFET
- Standard TO-220 package
- Compliant with 2002/95/EC European directive

Description

The VNP35N07-E, VNB35N07-E and VNV35N07-E are monolithic devices made using STMicroelectronics VIPower® technology, intended for replacement of standard Power MOSFETs in DC to 50 KHz applications.

Built-in thermal shutdown, linear current limitation and overvoltage clamp protect the chip in harsh environments.

Fault feedback can be detected by monitoring the voltage at the input pin.

Table 1. Device summary

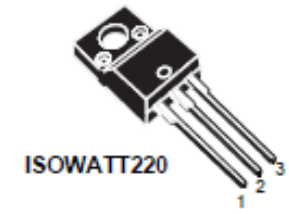
Package	Order codes	
	Tube	Tape and reel
TO-220	VNP35N07-E	VNP35N07TR-E
D^2PAK	VNB35N07-E	VNB35N07TR-E
PowerSO-10	VNV35N07-E	VNV35N07TR-E

VNP20N07FI
VNB20N07/VNV20N07

"OMNIFET": FULLY AUTOPROTECTED POWER MOSFET

TYPE	V_{clamp}	$R_{DS(on)}$	I_{lim}
VNP20N07FI	70 V	0.05 Ω	20 A
VNB20N07	70 V	0.05 Ω	20 A
VNV20N07	70 V	0.05 Ω	20 A

- LINEAR CURRENT LIMITATION
- THERMAL SHUT DOWN
- SHORT CIRCUIT PROTECTION
- INTEGRATED CLAMP
- LOW CURRENT DRAWN FROM INPUT PIN
- DIAGNOSTIC FEEDBACK THROUGH INPUT PIN
- ESD PROTECTION
- DIRECT ACCESS TO THE GATE OF THE POWER MOSFET (ANALOG DRIVING)
- COMPATIBLE WITH STANDARD POWER MOSFET



D2PAK
TO-263

PowerSO-10

DESCRIPTION

The VNP20N07FI, VNB20N07 and VNV20N07 are monolithic devices made using STMicroelectronics VIPower M0 Technology, intended for replacement of standard power MOSFETS in DC to 50 KHz applications. Built-in thermal shut-down, linear current limitation and overvoltage clamp protect the chip in harsh enviroments.

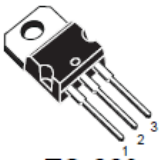
Fault feedback can be detected by monitoring the voltage at the input pin.

VN1160
VN1160-1 / VN1160T

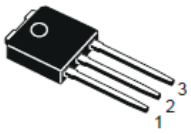
DIRECTION INDICATOR DRIVER FOR MOTORBIKE

TYPE	$R_{DS(on)}$	I_{lim}	V_{CC}
VN1160 VN1160-1 VN1160T	0.08 Ω	12 A	40 V

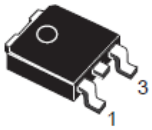
- COMPLETE DIRECTION INDICATOR IN A 3 PIN PACKAGE
- REQUIRES ONLY ONE EXTERNAL CAPACITOR TO SET FLASHING FREQUENCY
- DOUBLE FREQUENCY FLASHING IN LOW LOAD CONDITIONS
- CYCLE BY CYCLE OVERTEMPERATURE SHUTDOWN
- REVERSE BATTERY PROTECTION



TO-220



TO251 (IPAK)



TO252 (DPAK)

ORDER CODES

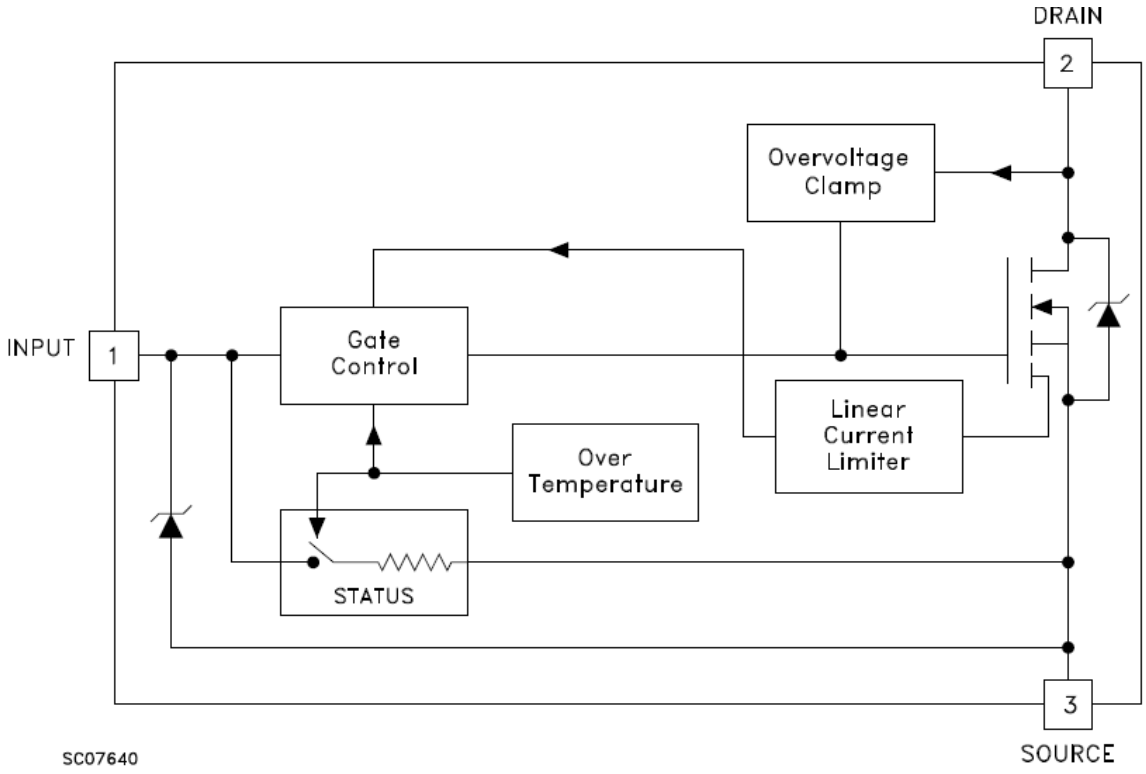
TO-252 (DPAK)	VN1160
TO-251 (IPAK)	VN1160-1
TO-220	VN1160T

DESCRIPTION

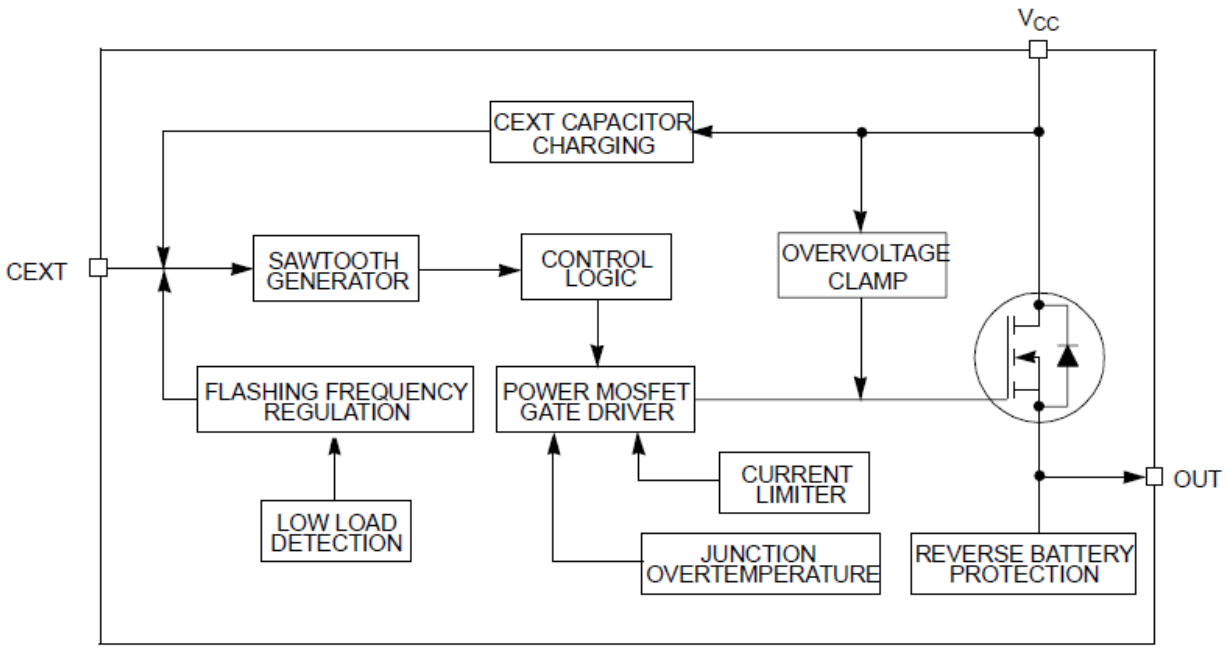
The VN1160, VN1160-1, VN1160T are a monolithic device made by using STMicroelectronics VIPower technology, intended for building a complete flashing unit for two wheel vehicles. The device is connected between the battery positive terminal (V_{CC} pin) and a mechanical switch to the right and/or left bulbs. As soon as the series switch connects the OUT pin to the bulbs, the device begins to turn on/off with a 50% duty cycle.
An external low voltage capacitor (220µF, 10V) connected between the CEXT pin and the OUT pin stores energy for powering the device during the ON phase and sets the flashing frequency.
When a low load is detected (output current lower than I_{df}), flashing frequency is automatically doubled.

2.2. Block diagram

VNP35N07, VNP20N07

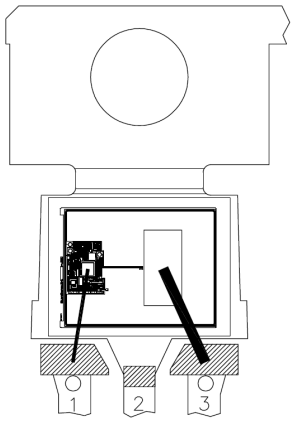


VN1160T

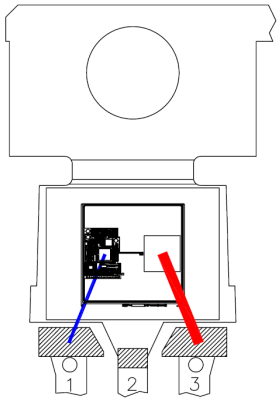


2.3. Bonding diagram

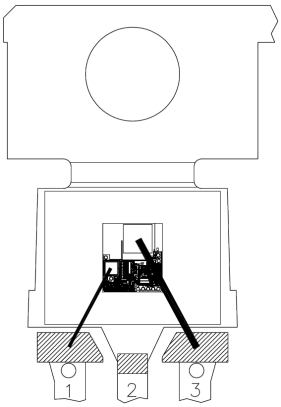
VNP35N07



VNP20N07



VN1160T



2.4 Traceability

2.4.1 Wafer Fab information

Device	VNP35N07	VNP20N07	VN1160T
Wafer fab name / location	ST Singapore SG6	ST Singapore SG6	ST Singapore SG6
Wafer diameter (inches)	6”	6”	6”
Silicon process technology	VIPower M02	VIPower M02	VIPower M03
Die finishing front side	SIN	SIN	SIN
Die finishing back side	Ti-Ni-Au	Ti-Ni-Au	Ti-Ni-Au
Die size (micron)	4290x5560	3870 x 3870	2190 x 2520
Metal levels/ materials/ thicknesses	1 /AlSi/ 3.2um	1 /AlSi/ 3.2um	1 /AlSi/ 3.4um

2.4.2 Assembly information

Assembly plant name / location	ST SHENZHEN (CHINA)
Package descrition	TO220
Lead frame finishing (material/thickness)	FRAME TO220 Mon Ve1 OpD/H 20U PlNi/NiP
Die attach material	PREFORM Pb/Ag/Sn 95.5/2.5/2
Wire bonding material/diameter	WIRE Al D5, Al D15
Molding compound material	RESIN SAMSUNG SI-7200DXC, LOCTITE HYSOL GR30
Package Moisture Sensitivity Level (JEDEC J-STD020D)	MSL3

2.4.3 Reliability Testing information

Reliability laboratory location	ST Catania (ITALY), ST Shenzhen (CHINA)

3 TESTS RESULTS SUMMARY

3.1 Lot Information

LOT #	TV	Diffusion Lot	Assy Lot	Molding Compound
1	VNP35N07	6904HXL	GK91510601	SAMSUNG (reference)
2			GK915106RR	HYSOL
3	VNP20N07	68475E6	GK91510X02	SAMSUNG (reference)
4			GK91510XRK	HYSOL
5	VN1160T	69050EK	GK91510A01	SAMSUNG (reference)
6			GK91510ARR	HYSOL

3.2 Tests results summary

Test method revision reference is the one active at the date of reliability trial execution.

TEST GROUP A – ACCELERATED ENVIRONMENT STRESS TESTS

Test	#	Reference	AEC-Q100 STM Test Conditions	Lots	S.S.	Total	Results FAIL/SS/ Lots	Comments
PC	A1	JESD22-A113 J-STD-020	24h bake@125°C, including 5 Temperature Cycling Ta=-40°C/+60°C ACC MSL3 (52h@60C/60%RH) 3x Reflow simulation Peak Reflow Temp= 260°C 100 Temperature Cycling Ta=-50°C/+150°C	-	-	-	-	Not Applicable
THB	A2	JESD22 A101 JESD22 A110	Ta=85°C, 85%RH, Duration= 1000hrs	6	77	462	0/77/6	
AC	A3	JESD22 A102 or JESD22 A118 or JESD22-A101	**ENV. SEQ.** **Environmental Sequence** TC (Ta=-65°C / +150°C for 100 cycles) + AC (Ta=121°C, Pa=2atm for 96 hours)	6	77	462	0/77/6	
TC	A4	JESD22 A104	Ta=-55°C /+150 °C Duration= 1000 cycles *See comment	6	77	462	0/77/6	*Read-out @500 thermal cycles Results will be updated after reaching 1000 cycles

PTC	A5	JESD22 A105	Ta=-40°C /+125 °C Duration=1000 cycles	6	45	270	0/45/6	
HTSL	A6	JESD22 A103	Ta= 150°C Duration= 1000hrs	6	77	462	0/77/6	

TEST GROUP B – ACCELERATED LIFETIME SIMULATION TESTS

Test	#	Reference	AEC-Q100 STM Test Conditions	Lots	S.S.	Total	Results FAIL/SS/Lots	Comments
HTOL	B1	JESD22 A108	TJ=150°C Duration= 1000hrs Bias dynamic stress (**OLT**)	-	-	-	-	
HTOL	B1	JESD22 A108	Ta=150°C Duration= 1000hrs Bias static stress (**HTB**)	6	77	462	0/77/6	
ELFR	B2	AEC-Q100-008	Ta max=150°C Duration=24hrs	6	800	4800	0/800/6	
EDR	B3	AEC-Q100-005	Specific tests and conditions to be defined in case of NVM	-	-	-	-	Not Applicable

TEST GROUP C – PACKAGE ASSEMBLY INTEGRITY TESTS

Test	#	Reference	AEC-Q100 STM Test Conditions	Lots	S.S.	Total	Results FAIL/SS/Lots	Comments
WBS	C1	AEC-Q100-001 AEC-Q003	Wire Bond Shear: (Cpk > 1.67)	6	min 5 units	min 15 units	All measurement within spec limits	
WBP	C2	Mil-STD-883, Method 2011 AEC-Q003	Wire Bond Pull: (Cpk > 1.67)	6	min 5 units	min 15 units	All measurement within spec limits	
SD	C3	JESD22 B102 JSTD-002D	Solderability: (>95% coverage) 8hr steam aging prior to testing	6	15	90	All measurement within spec limits	
PD	C4	JESD22 B100, JESD22 B108 AEC-Q003	Physical Dimensions: (Cpk > 1.67)	6	10	60	All measurement within spec limits	
SBS	C5	AEC-Q100-010 AEC-Q003	Only for BGA package	–	–	–	–	Not Applicable
LI	C6	JESD22 B105	Not required for Surface Mount Devices	–	–	–	–	Not Applicable

TEST GROUP D – DIE FABRICATION RELIABILITY TESTS

Test	#	Reference	AEC-Q100 STM Test Conditions	Lots	S.S.	Total	Results FAIL/SS/Lots	Comments
EM	D1	JESD61	Data, test method and criteria available upon request	–	–	–	–	Not Applicable
TDDB	D2	JESD35	Data, test method and criteria available upon request	–	–	–	–	Not Applicable
HCI	D3	JESD60 & 28	Data, test method and criteria available upon request	–	–	–	–	Not Applicable
NBTI	D4	JESD90	Data, test method and criteria available upon request	–	–	–	–	Not Applicable
SM	D5	JESD61, 87, & 202	Data, test method and criteria available upon request	–	–	–	–	Not Applicable

TEST GROUP E – ELECTRICAL VERIFICATION

Test	#	Reference	AEC-Q100 STM Test Conditions	Lots	S.S.	Total	Results FAIL/SS/Lots	Comments
TEST	E1	User/Supplier Specification	Pre and Post Stress Electrical Test	All	All	All	Passed	All parametric and functional tests
HBM	E2	AEC-Q100-002	Target: ±2kV	–	–		–	Not Applicable
CDM	E3	AEC-Q100-011	Target: ±750V on corner pins ± 500V all others	–	–		–	Not Applicable
LU	E4	AEC-Q100-004	Current Injection Class II – Level A (+/– 100mA)	–	–	–	–	Not Applicable
ED	E5	AEC-Q100-009 AEC-Q003	Electrical Distributions: (Test @ Rm/Hot/Cold) (where applicable, Cpk >1.67)	–	–	–	–	Not Applicable
EMC	E9	SAE J1752/3	Electromagnetic Compatibility (Radiated Emissions)	–	–	–	–	Not Applicable
SC	E10	AEC Q100-012	Short Circuit Characterization	–	–	–	–	Not Applicable
SER	E11	JESD89-1 JESD89-2 JESD89-3	Applicable to devices with memory	–	–	–	–	Not Applicable
LF	E12	AEC-Q005	Lead(Pb) Free: (see AEC-Q005)	–	–	–	–	Not Applicable

TEST GROUP F – DEFECT SCREENING TESTS

Test	#	Reference	AEC-Q100 STM Test Conditions	Lots	S.S.	Total	Results FAIL/SS/Lots	Comments
PAT	F1	AEC-Q001	Process Average Testing: (see AEC-Q001)	Not performed on qualification lots. It will be implemented starting from first production lot				
SBA	F2	AEC-Q002	Statistical Bin/Yield Analysis: (see AEC-Q002)					

TEST GROUP G - CAVITY PACKAGE INTEGRITY TESTS

Test	#	Reference	AEC-Q100 STM Test Conditions	Lots	S.S.	Total	Results FAIL/SS/Lots	Comments
MS	G1	JESD22 B104	Mechanical Shock	Not Applicable: not for plastic packaged devices				
VFV	G2	JESD22 B103	Variable Frequency Vibration					
CA	G3	MIL-STD-883 Method 2001	Constant Acceleration					
GFL	G4	MIL-STD-883 Method 1014	Gross and Fine Leak					
DROP	G5		Drop Test, Package Drop					
LT	G6	MIL-STD-883 Method 2004	Lid Torque					
DS	G7	MIL-STD-883 Method 2019	Die Shear					
IWV	G8	MIL-STD-883 Method 1018	Internal Water Vapor					

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Conclusions

- The introduction of Hysol GR30 molding compound for all products assembled in TO220 package manufactured in ST Shenzhen (China) assembly plant, ensuring :
  - the same electrical characteristics as per current production;
  - no modify of the current Assembly Process Flow quality and guarantees the same electrical characteristics as per current production.