

PRODUCT / PROCESS CHANGE NOTIFICATION

1. PCN basic data

1.1 Company		STMicroelectronics International N.V
1.2 PCN No.	ADG/20/11903	
1.3 Title of PCN	VNB35N07xx, VNB20N07xx (VN19, VN29): Double Bonding Introduction (2x10mils Al wire)	
1.4 Product Category	see list	
1.5 Issue date	2020-04-14	

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), Bond wire material, diameter	ST Shenzhen (China)

4. Description of change

	Old	New
4.1 Description	One 15 mils Aluminum bond wire	Two 10 mils Aluminum bond wires
4.2 Anticipated Impact on form,fit, function, quality, reliability or processability?	No Impact	

5. Reason / motivation for change

5.1 Motivation	Manufacturing Flexibility. Material standardization (wires)
5.2 Customer Benefit	MANUFACTURING FLEXIBILITY

6. Marking of parts / traceability of change

6.1 Description	Dedicated Finished Good Codes
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7. Timing / schedule

7.1 Date of qualification results	2020-04-10
7.2 Intended start of delivery	2020-07-10
7.3 Qualification sample available?	Upon Request

8. Qualification / Validation

8.1 Description	11903 Validation.pdf		
8.2 Qualification report and qualification results	Available (see attachment)	Issue Date	2020-04-14

9. Attachments (additional documentations)

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
	VNB20N07-E	
	VNB20N07TR-E	
	VNB35N07-E	
	VNB35N07TR-E	

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Shenzhen TO263 (D2PAK) VN19-VN29 doubling aluminum wire

Outline

- Slide 3 – Description
- Slide 4 – BOM comparison
- Slide 5 – ZVEI Guidelines
- Slide 6 – Test vehicle
- Slide 7 – Reliability Evaluation Report
- Slide 20 – Conclusion

Change description

- The purpose of this document is to report the qualification activity performed on the two silicon lines VN19 and VN29 assembled in TO263 (D2PAK) package at ST Shenzhen plant (China). The qualification evidences reported hereafter are related to the replacement of the 15mils aluminum wire on Source pad with two 10mils aluminum wires.
- Compared with all the VIPower® products assembled in TO263(D2PAK), the VN19 and VN29 are the only 2 using the 15mils aluminum wire, so the change is proposed in order to standardize the wire material and to improve the line efficiency. Moreover the usage of 10mils wire needs less ultrasonic power during wire bonding operation and that will reduce the mechanical stress to the bonding pad.
- This report shows the positive results achieved by the usage of the double 10mils aluminum wire on Source pad without changing the current assembly process flow and while ensuring the same quality and electrical characteristics as VN19 and VN29 product lines assembled in TO263(D2PAK) package.

BOM comparison

Current Bill of Material	
ITEM	MATERIAL
WIRE	WIRE Aluminum D15
WIRE	WIRE Aluminum D5
FRAME	FRAME TO263
PREFORM	PREFORM Pb/Ag/Sn
RESIN	RESIN SUMITOMO EME7026



New Bill of Material	
ITEM	MATERIAL
WIRE	WIRE Aluminum D10
WIRE	WIRE Aluminum D5
FRAME	FRAME TO263
PREFORM	PREFORM Pb/Ag/Sn
RESIN	RESIN SUMITOMO EME7026

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		
X	SEM-PA-08	Change of wire bonding	P	P	Material, diameter, change in bonding diagram and / or change in process resulting in a new technology.	e.g. change from Au to Cu material e.g. change from 25µm to 23µm diameter e.g. change from single to double bond e.g. change from stich bond to stich on ball bond.

Extract from ZVEI **ZVEI:**
Die Elektroindustrie

Selected Test Vehicle

- VIPower® M0A2 Technology:
 - TO263 (D2PAK) : VNB35N07-E / VNB35N07TR-E (Silicon Line VN19)
 - TO263 (D2PAK) : VNB20N07-E / VNB20N07TR-E (Silicon Line VN29)

Reliability Evaluation Report

VNB35N07, VNB20N07 new BOM assessment

General Information	
Commercial Product :	VNB35N07, VNB20N07
Product Line :	VN19, VN29
Package :	D2PAK
Silicon Technology :	VIpower-M02

***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	A. Vilaro	27/11/2019

Approved by

Function	Location	Name	Date
Division Reliability Manager	ST Catania (Italy)	A. Marmoni	27/11/2019

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1 RELIABILITY EVALUATION OVERVIEW

1.1 Objective

Aim of this report is to present the results of the reliability evaluations performed on **VNB35N07** and **VNB20N07** (VN19 and VN29 as ST internal silicon line) to evaluate a wire bonding change on source pad. Because of these are the only two ViPower products assembled in the D2Pak using 15mils wire, the change is proposed in order to standardize the wire material and to improve the line efficiency reducing the equipment set-up.

Moreover the usage of 10mil wire needs less ultrasonic power during wire bonding operation and will reduce the mechanical stress to the bonding pad.

VNB35N07 and VNB20N07 are OMNIFET fully auto-protected Power MOSFET, intended for replacement of standard power MOSFETS in DC to 50 KHz applications.

Both the devices are designed in VIPower M02 technology, assembled in ST Shenzhen (CHINA) in D2PAK package and diffused in ST Catania CT6" (Italy) Wafer fab the VNB35N07 and in ST Singapore SG6" wafer fab the VNB20N07.

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)	Yes
	THB	Temperature Humidity Bias	Yes
	AC	Autoclave at 2atm	Yes
	TC	Temperature Cycling	Yes
	PTC	Power Temperature Cycling	Not Applicable
	HTSL	High Temperature Storage Life	Yes
B Accelerated Lifetime Simulation Tests	HTOL	High Temperature Operating Life	Not Applicable
	ELFR	Early Life Failure Rate	Not Applicable
	EDR	Endurance Data Retention	Not Applicable
C Package Assembly Integrity Tests	WBS	Wire Bond Shear	Yes
	WBP	Wire Bond Pull	Yes
	SD	Solderability	Not Applicable
	PD	Physical Dimension	Not Applicable
	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	No
	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	TDD	BHCI	NBT	ISM	HBM	CDM	LU	ED	EMC	SC
AEC-Q100	x	x	x	*	x			x	x													x
ZVEI	x	x	x	*	x			x	x			x										x
ST	x	x	x		x			x	x													

Rationale for ST qualification plan:

- * PTC not applicable, performed only when wire diameter decreases.
- EM test is part of the ZVEI Die Fabrication Reliability Tests and therefore it is to be performed in case of Front End changes
- SC: not performed because considering that was not performed at time of product release in the market, no gap analysis to be done as effect of these changes. More over as per AEC–Q100 this test should be performed per agreement between customer and supplier.

1.3 Conclusion

All reliability tests (1x AEC–Q100 requirement) have been completed with positive results. Neither functional nor parametric rejects were detected at final electrical testing.

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.

Based on the overall results obtained, replacing 1X 15mil Al wire with 2X 10mil Al wires in VNB35N07, VNB20N07 devices assembled in D2PAK package in SHENZHEN , positively passed reliability evaluation performed in agreement to AEC_Q100 Rev.H.

2. Product Characteristics

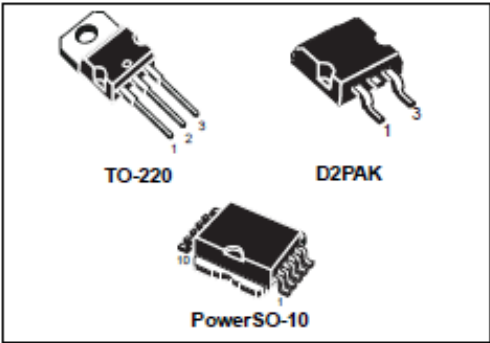
2.1. Generalities



VNP35N07-E, VNB35N07-E, VNV35N07-E

OMNIFET: fully autoprotected Power MOSFET

Datasheet - production data



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

- 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.

- Automotive qualified
- Linear current limitation
- Thermal shutdown
- Short circuit protection
- Integrated clamp
- Low current drawn from input pin

Table 1. Device summary

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



VNP20N07FI
VNB20N07/VNV20N07

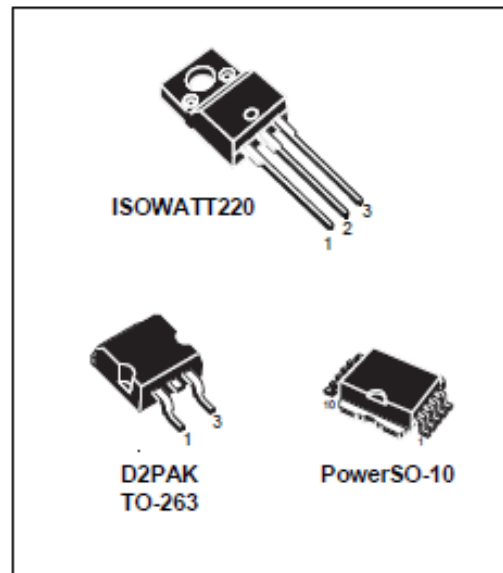
"OMNIFET":
FULLY AUTOPROTECTED POWER MOSFET

TYPE	V _{olamp}	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

DESCRIPTION

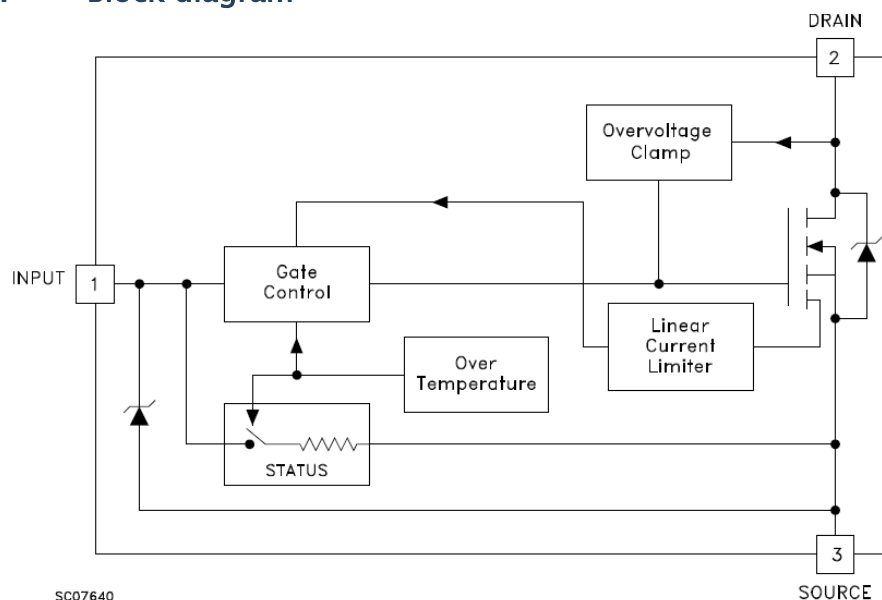
The VNP20N07FI, VNB20N07 and VNV20N07 are monolithic devices made using STMicroelectronics VIPower M0 Technology, intended for replacement of standard power MOSFETs in DC to 50 KHz applications. Built-in thermal shut-down, linear current limitation and overvoltage clamp protect the chip in harsh



enviroments.

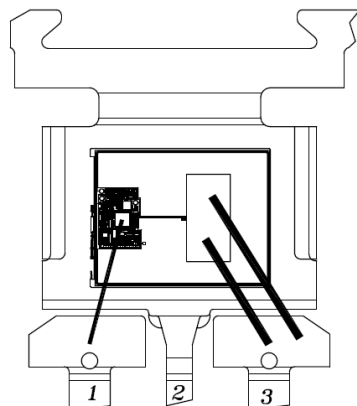
Fault feedback can be detected by monitoring the voltage at the input pin.

2.2. Block diagram

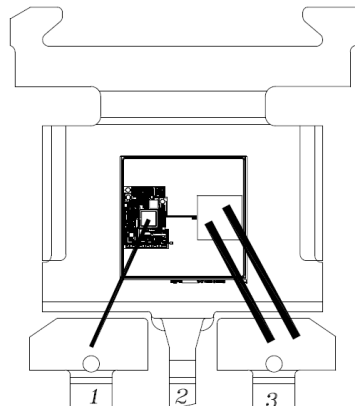


2.3. Bonding diagram

VNB35N07



VNB20N07



2.4 Traceability

2.4.1 Wafer Fab information

Device	VNB35N07	VNB20N07
Wafer fab name / location	ST Catania CT6	ST Singapore SG6
Wafer diameter (inches)	6"	6"
Silicon process technology	VIPower M0A2	VIPower M0A2
Die finishing front side	SIN	SIN
Die finishing back side	Ti-Ni-Au	Ti-Ni-Au
Die size (micron)	4290x5560	3870 x 3870
Metal levels/ materials/ thicknesses	1 /AlSi/ 3.2um	1 /AlSi/ 3.2um

2.4.2 Assembly information

Assembly plant name / location	ST SHENZHEN (CHINA)
Package description	D2PAK
Lead frame finishing (material/thickness)	FRAME TO263 Dt 40u Ve5 OptF/G/H SeINiNiP
Die attach material	PREFORM Pb/Ag/Sn 95.5/2.5/2
Wire bonding material/diameter	WIRE Al D5, Al D10
Molding compound material	RESIN SUMITOMO EME7026
Package Moisture Sensitivity Level (JEDEC J-STD020D)	MSL3

2.4.3 Reliability Testing information

Reliability laboratory location	ST Catania (ITALY), ST Shenzhen (CHINA)
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3 TESTS RESULTS SUMMARY

3.1 Lot Information

Lot #	Diffusion Lot	Assy Lot	Note
1	3816866	GK84018301	VNB35N07
2	6820KJ7	GK84017Y01	VNB20N07
3	6827JPH	GK84018001	VNB20N07
4	6829F5J	GK8440UQ01	VNB20N07 Reference Lot

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	4	231	924	0/231/4	
THB	A2	JESD22 A101 JESD22 A110	Ta=85°C, 85%RH, Duration= 1000hrs	4	77	308	0/77/4	
AC	A3	JESD22 A102 or JESD22 A118 or JESD22-A A101	ENV. SEQ. Environmental Sequence TC (Ta=-65°C / +150°C for 100 cycles) + AC (Ta=121°C, Pa=2atm for 96 hours)	4	77	308	0/77/4	
TC	A4	JESD22 A104	Ta=-55°C /+150 °C Duration= 1000 cycles	4	77	308	0/77/4	
PTC	A5	JESD22 A105	Ta=-40°C /+125 °C Duration=1000 cycles	-	-	-	-	Not Applicable
HTSL	A6	JESD22 A103	Ta= 150°C Duration= 1000hrs	4	77		0/77/4	

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)	-	-	-	-	Not Applicable
HTOL	B1	JESD22 A108	Ta=150°C Duration= 1000hrs Bias static stress (HTB)	-	-	-	-	Not Applicable
ELFR	B2	AEC-Q100-008	Ta max=150°C Duration=24hrs	-	-	-	-	Not Applicable
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)	4	min 5 units	min 15 units	All measurement within spec limits	All assembly lots
WBP	C2	Mil-STD-883, Method 2011 AEC-Q003	Wire Bond Pull: (Cpk > 1.67)	4	min 5 units	min 15 units	All measurement within spec limits	All assembly lots
SD	C3	JESD22 B102 JSTD-002D	Solderability: (>95% coverage) 8hr steam aging prior to testing	-	-	-	-	Not Applicable
PD	C4	JESD22 B100, JESD22 B108 AEC-Q003	Physical Dimensions: (Cpk > 1.67)	-	-	-	-	Not Applicable
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: $\pm 2\text{kV}$	-	-	-	-	Not Applicable
CDM	E3	AEC-Q100-011	Target: $\pm 750\text{V}$ on corner pins $\pm 500\text{V}$ all others	-	-	-	-	Not Applicable
LU	E4	AEC-Q100-004	Current Injection Class II – Level A ($\pm 100\text{mA}$)	-	-	-	-	Not Applicable
ED	E5	AEC-Q100-009 AEC-Q003	Electrical Distributions: (Test @ Rm/Hot/Cold) (where applicable, $C_{pk} > 1.67$)	-	-	-	-	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 doubling aluminum wire performed on VN19 and VN29 product lines, assembled in TO263(D2PAK) package in ST Shenzhen plant (China) ensures:
 - no change on quality about the current assembly process flow;
 - the same electrical characteristics for the product lines impacted.



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PCN Title : VNB35N07xx, VNB20N07xx (VN19, VN29): Double Bonding Introduction (2x10mils Al wire)

PCN Reference : ADG/20/11903

Subject : Public Products List

Dear Customer,

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

VNB20N07-E	VNB35N07-E	VNB35N07TR-E
VNB20N07TR-E	VNP35N07-E	



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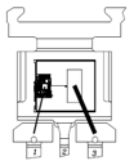
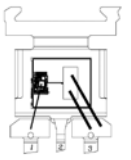
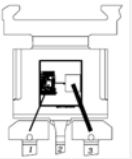
Resale of ST products with provisions different from the information set forth herein shall void any warranty granted by ST for such product.

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PRODUCT/PROCESS CHANGE NOTIFICATION

SUBJECT VNB35N07xx, VNB20N07xx (VN19, VN29): Double Bonding Introduction (2x10mils Al wire)

IMPACTED PRODUCTS	Below VIPower products housed in D2PAK package <table border="1"> <thead> <tr> <th>Line</th><th>Commercial Product</th></tr> </thead> <tbody> <tr> <td>VN19</td><td>VNB35N07-E</td></tr> <tr> <td>VN19</td><td>VNB35N07TR-E</td></tr> <tr> <td>VN29</td><td>VNB20N07-E</td></tr> <tr> <td>VN29</td><td>VNB20N07TR-E</td></tr> </tbody> </table>	Line	Commercial Product	VN19	VNB35N07-E	VN19	VNB35N07TR-E	VN29	VNB20N07-E	VN29	VNB20N07TR-E
Line	Commercial Product										
VN19	VNB35N07-E										
VN19	VNB35N07TR-E										
VN29	VNB20N07-E										
VN29	VNB20N07TR-E										
MANUFACTURING STEP	Assembly										
INVOLVED PLANT	ST Shenzhen (China)										
CHANGE REASON	Manufacturing Flexibility. Material standardization (wires)										
CHANGE DESCRIPTION	In order to standardize the assembly processes, on VNB35N07xx and VNB20N07xx will be implemented the doubling wire bonding on source pad, replacing the single 15 mils aluminum wire with double 10 mils aluminum wire. Current  New  VNB35N07   VNB20N07 ZVEI classification SEM-PA-08										

TRACEABILITY	Dedicated Finished Goods Codes
VALIDATION	Validation results enclosed in this communication 11903 Validation.pdf
SAMPLES	Available on demand
IMPLEMENTATION	We are ready to implement the change upon Customer agreement