PRODUCT/PROCESS CHANGE NOTIFICATION

PCN APG-ABD/13/8119
Dated 27 Sep 2013

VND5E050Axx, VND5E050Mxx : Thermal Shutdown Improvement

Table 1. Change Implementation Schedule

Forecasted implementation date for change	01-Oct-2013
Forecasted availability date of samples for customer	20-Sep-2013
Forecasted date for **STMicroelectronics** change Qualification Plan results availability	20-Sep-2013
Estimated date of changed product first shipment	27-Dec-2013

Table 2. Change Identification

Product Identification (Product Family/Commercial Product)	See enclosed list (page 5)
Type of change	Product design change
Reason for change	Thermal Shutdown Improvement
Description of the change	Please be informed that in order to improve the Thermal shutdown of VND5E050Axx, VND5E050Mxx (Silicon line VNQ5,VNU1) a new silicon revision of those products had been qualified. New part numbers have been created in orded to maintain traceability.
Change Product Identification	Dedicated Part Numbers
Manufacturing Location(s)	

DOCUMENT APPROVAL

Name	Function
Liporace, Nicola	Marketing Manager
Nicoloso, Riccardo	Product Manager
Minerva, Francesco	Q.A. Manager

PCN
Product Change Notification

VND5E050Axx, VND5E050Mxx : Thermal Shutdown Improvement

WHAT:

In order to improve the Thermal Shutdown of VND5E050Axx, VND5E050Mxx (Silicon lines VNQ5, VNU1) a new silicon revisions of those products had been qualified.
New part numbers had been created in order to maintain traceability.
See Below Table

Current part number	New Part Number
VND5E050AJTR-E	VND5E050ACJTR-E
VND5E050AKTR-E	VND5E050ACKTR-E
VND5E050MJTR-E	VND5E050MCJTR-E
VND5E050MKTR-E	VND5E050MCKTR-E

WHY:

Thermal Shutdown Improvement

HOW:

New silicon revision had been qualified as per attached report **RR003911CT6025.**
Samples available on customer's request through our Sales offices.
We strongly recommend to all the Customers involved to start the swap to the new product versions.

WHEN:

We are ready to move production to new commercial products upon customers agreement .

VND5E050ACJ-E (VNQ5)
New 50mΩ Double Channel High Side Driver

New Product Qualification

General Information	
Product Line	VNQ5
Commercial Product	VND5E050ACJ-E
Silicon process technology	VIPower M0_5
Package	PowerSSO_12

Locations	
Diffusion fab location	ST CT6 Catania (Italy)
Assembly plant location	ST Bouskoura (Morocco)
Test plant location	ST Bouskoura (Morocco)
Reliability lab location	ST Catania (Italy)

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- 1. Reliability evaluations overview

1.1 Objectives

Aim of this report is to present the results of the reliability evaluations performed on **VND5E050ACJ-E** (VNQ5 as ST internal silicon line) in order to release the device to production volume. This is a double channels high side driver with analog current sense for Automotive Applications designed in VIPower M05E technology, diffused in ST CT6 Catania (Italy) 6" wafer fab and assembled by ST Bouskoura (Morocco) in PowerSSO_12 package.

The **VND5E050ACJ-E** is a derivative product of the **VND5E050AJ-E** that was qualified through a family approach by using other VIPower products designed in the same technology and package chosen as test vehicles (see ST reference report #RR000408CT6029_Rev.A).

The **VND5E050ACJ-E** differs from the derivative product **VND5E050AJ-E** only for a circuit rerouting done in order to change the hot sensor position. The reliability evaluation was based on three lots, according with the **AEC_Q100 Rev.G** specification the test performed were the Preconditioning (PC), Thermal Cycling (TC) and Power Temperature Cycling (PTC) as Accelerated Environment Stress (test Group A) while ESD (MM, HBM, CDM) and Latch-UP (LU) characterization, Gate Leakage (GL), Electromagnetic Compatibility (EMC), Electrical Characterization and Short Circuit Characterization (according with the **AEC_Q100-012)** as Electrical Verification (test Group E).

In this report revision the PTC test details are reported:

- Real load bulbs P27W+R5W, Ton=20ms, Toff=12s, Tamb=-40˚C/+125˚C, 1000 cycles, 300k activations

1.2 Results

All reliability tests have been completed with positive results, neither functional nor parametric rejects were detected at final electrical testing.

The Short Circuit Characterization results are showed by means a Weibull plot usage.

Based on the overall positive results we consider the products qualified from a reliability point of view.

- 2. Traceability

Wafer fab information	
Wafer fab manufacturing location	ST CT6 CATANIA (Italy)
Wafer diameter (inches)	6
Silicon process technology	VIPower M0_A5
Die finishing back side	Ti-Ni-Au
Die size (micron)	3910x2150
Metal levels / materials	2 levels / Ti/TiN/Ti/AlSiCu (3.2 µm last level)
Die finishing front side	SiN/POLYIMIDE
Diffusion Lots #	Lot_1: 3110964, Lot_2: 3110964C, Lot_3: 3110965

Assembly Information	
Assembly plant location	ST Bouskoura (Morocco)
Package description	PowerSSO_12
Molding compound	RESIN SUMITOMO EME7026
Wires bonding materials/diameters	Au 1.3 mils (input) / Au 3.0 mils (output)
Die attach material	PREFORM Pb/Ag/Sn 95.5/2.5/2
Assembly Lots #	Lot_1:CZ1170TW01, Lot_2:CZ1240B201, Lot_3:CZ1210AD01

Final Testing Information	
Electrical testing manufacturing location	ST Bouskoura (Morocco)

Reliability Information	
Reliability test execution location	ST Catania (Italy)

- 3. Devices characteristics

3.1 Generalities

VND5E050ACJ-E
VND5E050ACK-E

Double channel high-side driver with analog current sense for automotive applications

Features

Max transient supply voltage	V_{CC}	41 V
Operating voltage range	V_{CC}	4.5 to 28 V
Max On-state resistance (per ch.)	R_{ON}	50 mΩ
Current limitation (typ)	I_{LIMH}	27 A
Off-state supply current	I_S	2 µA(1)

1. Typical value with all loads connected.

- General
  - Inrush current active management by power limitation
  - Very low standby current
  - 3.0 V CMOS compatible inputs
  - Optimized electromagnetic emissions
  - Very low electromagnetic susceptibility
  - Compliance with European directive 2002/95/EC
  - Very low current sense leakage
- Diagnostic functions
  - Proportional load current sense
  - High current sense precision for wide currents range
  - Current sense disable
  - Off-state open load detection
  - Output short to V_{CC} detection
  - Overload and short to ground (power limitation) indication
  - Thermal shutdown indication
- Protections
  - Undervoltage shutdown
  - Overvoltage clamp
  - Load current limitation
  - Self limiting of fast thermal transients
  - Protection against loss of ground and loss of V_{CC}
  - Overtemperature shutdown with auto restart (thermal shutdown)

PowerSSO-12 PowerSSO-24

  - Reverse battery protected
  - Electrostatic discharge protection

Applications

- All types of resistive, inductive and capacitive loads
- Suitable as LED driver

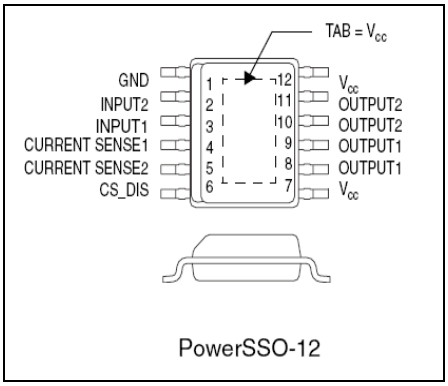
Description

The VND5E050ACJ-E and VND5E050ACK-E are double channel high-side drivers manufactured using ST proprietary VIPower® M0-5 technology and housed in PowerSSO-12 and PowerSSO-24 packages. The devices are designed to drive 12 V automotive grounded loads, and to provide protection and diagnostics. They also implement a 3 V and 5 V CMOS-compatible interface for use with any microcontroller.

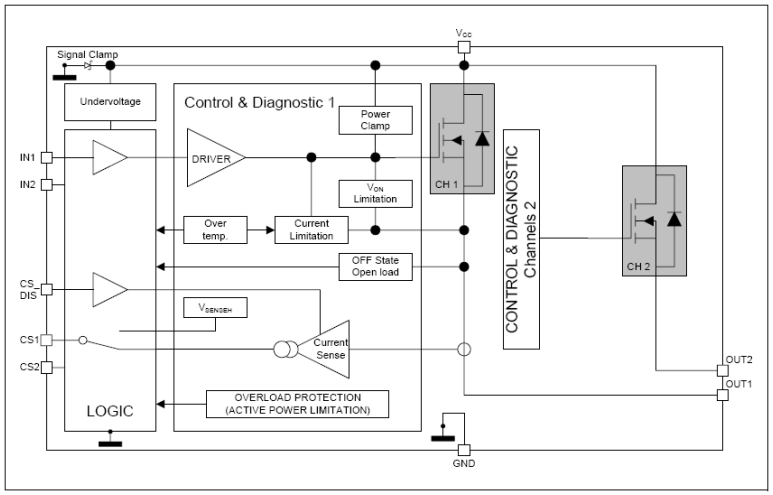
The devices integrate advanced protective functions such as load current limitation, inrush and overload active management by power limitation, overtemperature shut-off with auto-restart and overvoltage active clamp. A dedicated analog current sense pin is associated with every output channel providing enhanced diagnostic functions including fast detection of overload and short-circuit to ground through power limitation indication, overtemperature indication, short-circuit to V_{CC} diagnosis on-state and off-state open-load detection.

The current sensing and diagnostic feedback of the whole device can be disabled by pulling the CS_DIS pin high to share the external sense resistor with similar devices.

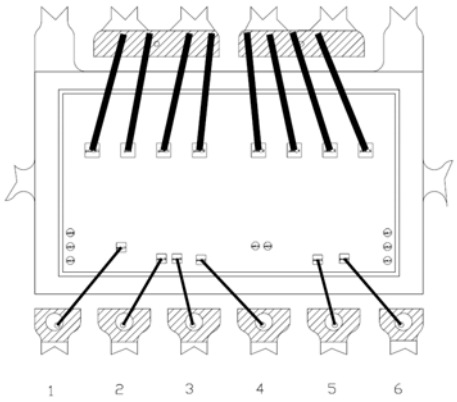
3.2 Pins connection



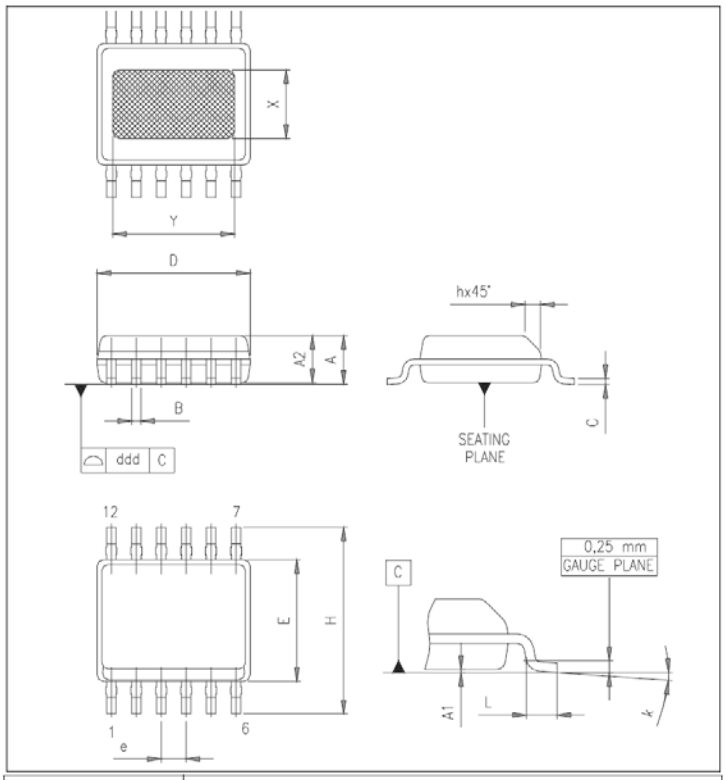
3.3 Blocks diagram



3.4 Bonding diagram



3.5 Package outline/Mechanical data

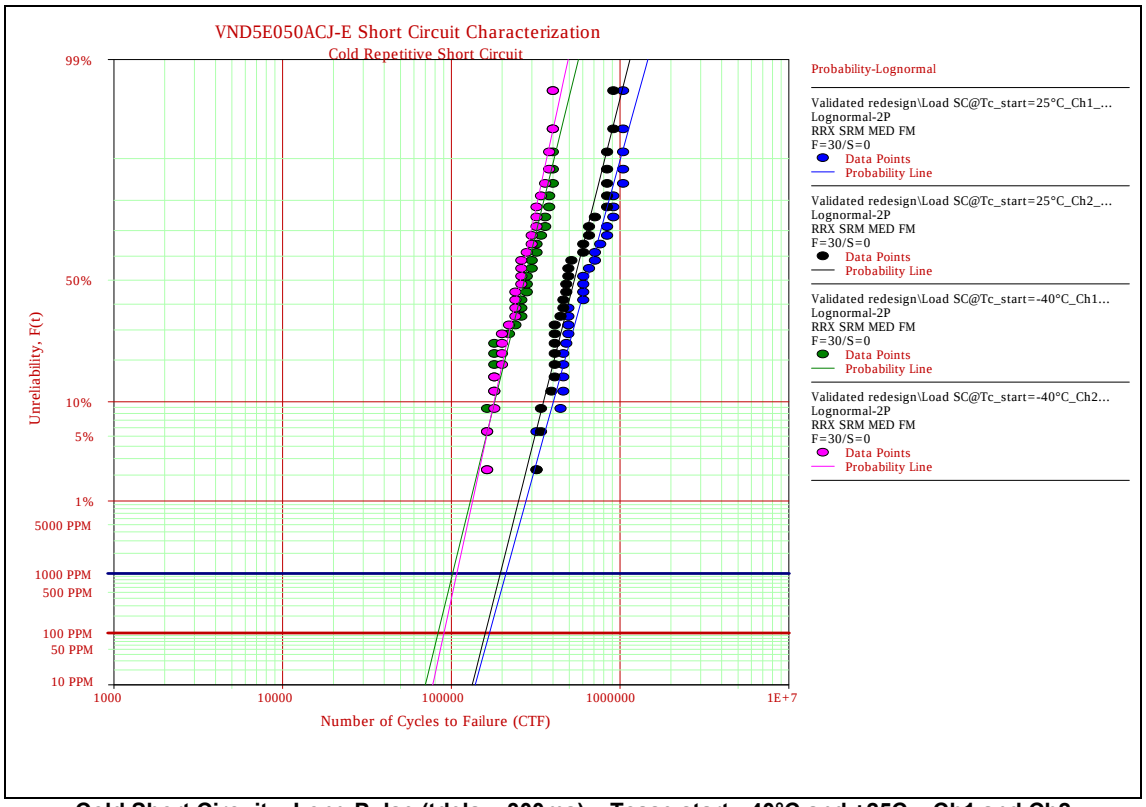


Symbol	Millimeters		
	Min.	Typ.	Max.
A	1.25		1.62
A1	0		0.1
A2	1.10		1.65
B	0.23		0.41
C	0.19		0.25
D	4.8		5.0
E	3.8		4.0
e		0.8	
H	5.8		6.2
h	0.25		0.5
L	0.4		1.27
k	0°		8°
X	1.9		2.5
Y	3.6		4.2
ddd			0.1

- 4. Reliability qualification plan and results

AEC #	Test Name	STM Test Conditions	Sample Size/ Lots	Results Fails/SS/Lots	Comments
A1	**PC** Pre Cond	Preconditioning at Jedec Level 3, store 192 hours at Ta=30ºC, RH=60%, reflow (3 times) at 260ºC + Thermal Cycles @ Ta=-40ºC/+60ºC for 5 cycles	Before TC, PTC		
A4	**TC** Temp. Cycling	Ta=-65ºC / +150ºC for 500 cycles	77/3	0/77/3	
A5	**PTC** Power Temp. Cycling	Ta=-40ºC / +125ºC for 1000 cycles.	45/1	0/45/1	Real load bulbs P27W+R5W Ton=20ms Toff=12s 300k activations
E2	**ESD** HBM		1 lot	**HBM:** ±5KV Vcc/Out ±4KV In/CsD ±2KV Cs	
E3	**ESD** CDM		1 lot	**CDM:** ±750V	
E4	**LU** Latch-Up		6/1	±100mA	
E7	**CHAR** Charact.		3 lots	Completed	
E8	**GL** Gate Leakage		6/1	0/6/1	
E9	**EMC** Electromag. Compatibility		1 lot	Completed	
E10	**SC** Short Circuit	Per AEC-Q100-012 Cold Short Circuit Long Pulse (300ms) @ T=-40ºC and T=+25ºC	10/3	Completed	Results showed in next section

- 5. Short Circuit Results – Weibull plot



Cold Short Circuit – Long Pulse (tdelay=300ms) – Tcase start=-40°C and +25C – Ch1 and Ch2

AEC #	Test Name	STM Test Conditions	Sample Size/ Lots	Cumulative Failures	# of Cycles
E10	**SC** Short Circuit	Cold Short Circuit, Long Pulse (300ms), Tc-start=**-40°C**, Load – **Ch1**	10/3	100 ppm	84000
				1000 ppm	103000
		Cold Short Circuit, Long Pulse (300ms), Tc-start=**-40°C**, Load – **Ch2**	10/3	100 ppm	91000
				1000 ppm	108000
		Cold Short Circuit, Long Pulse (300ms), Tc-start=**25°C**, Load – **Ch1**	10/3	100 ppm	160000
				1000 ppm	199000
		Cold Short Circuit, Long Pulse (300ms), Tc-start=**25°C**, Load – **Ch2**	10/3	100 ppm	169000
				1000 ppm	213000

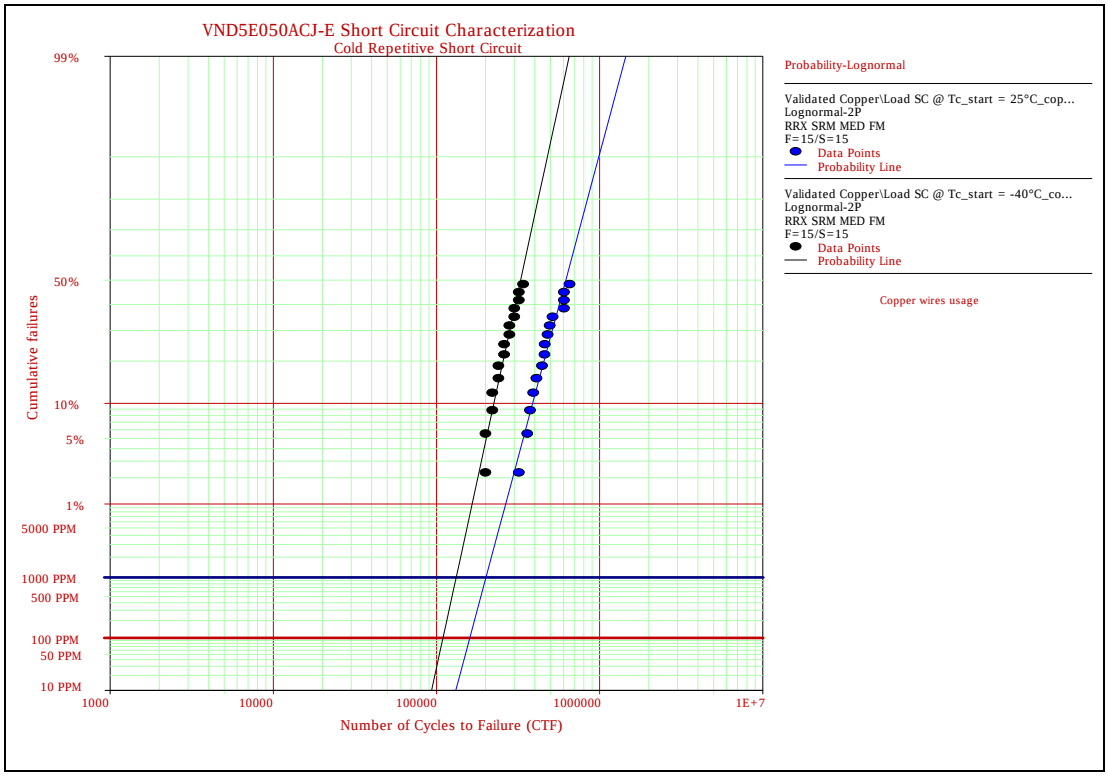
- 6. VND5E050ACJ-E: Copper wires product's version

All the **VND5E050ACJ-E** product qualification described in the previous sections was done by using samples assembled with a full Gold wires configuration as documented in the assembly information showed in section Traceability at pag.4 of this report.

The same product is also available with a mix of Gold and Copper wires using 2.5mil copper wires instead of 3 mil Gold ones on power pins while and keeping unchanged the thin 1.3mil Gold wire for the control pins.

The qualification of this new bonding set for all the VIPower products designed in M0_5 technology housed in package PowerSSO_12 was done choosing as test vehicle the derivative product **VND5E050AJ-E** performing a full qualification according with the **AEC_Q100 Rev.G** specification (see ST reference report # RR000111CT6029_Rev.A).

The only test performed just on the **VND5E050ACJ-E** assembled with Copper wires is the Short Circuit Characterization (according with the **AEC_Q100-012)** as Electrical Verification (test Group E), the results are showed below:



Cold Short Circuit – Long Pulse (tdelay=300ms) – Tcase start= -40°C and +25C

AEC #	Test Name	STM Test Conditions	Sample Size/ Lots	Cumulative Failures	# of Cycles
E10	**SC** Short Circuit	Cold Short Circuit, Long Pulse (300ms), Tc-start=**-40°C**, Load	10/3	100 ppm	112000
				1000 ppm	134000
		Cold Short Circuit, Long Pulse (300ms), Tc-start=**25°C**, Load	10/3	100 ppm	162000
				1000 ppm	207000

- 7. VND5E050ACJ-E Gold vs Copper: full AEC-Q100 reliability table summary

Test group A: Accelerated Environment Stress Tests

Test #	Stress Test	Samples size/Lots	VND5E050ACJ-E Gold wires	VND5E050ACJ-E Copper wires
A1	Pre Conditioning (PC)	All samples	3 lots	Covered by VND5E050AJ-E Copper wires
A2	Temperature Humidity Bias (THB)	77/3	Covered by VND5E050AJ-E Gold wires	
A3	Autoclave (AC)	77/3		
A4	Temperature Cycling (TC)	77/3	3 lots	
A5	Power Temperature Cycle (PTC)	45/1	1 lot	
A6	High Temperature Storage Life (HTSL)	45/3	Covered by VND5E050AJ-E Gold wires	

Test group B: Accelerated Lifetime Simulation Tests

Test #	Stress Test	Samples size/Lots	VND5E050ACJ-E Gold wires	VND5E050ACJ-E Copper wires
B1	High Temperature Operating Life (HTOL)	77/3	Covered by VND5E050AJ-E Gold wires	Not requested
B2	Early Life Failure Rate (ELFR)	800/3		
B3	Endurance Data Retention (EDR)	77/3	Not Applicable (only for memory devices)	

Test group C: Package Assembly Integrity Tests

Test #	Stress Test	Samples size/Lots	VND5E050ACJ-E Gold wires	VND5E050ACJ-E Copper wires
C1	Wire Bond Shear (WBS)	30 bonds for a minimun of 5 devices	Covered by VND5E050AJ-E Gold wires	Covered by VND5E050AJ-E Copper wires
C2	Wire Bond Pull (WBP)			
C3	Solderability (SD)	15/1		
C4	Physical Dimensions (PD)	10/3		
C5	Solder Ball Shear (SBS)	5 balls from 10 parts/3	Not Applicable (only for BGA package)	
C6	Lead Integrity (LI)	10 lead from 5 parts/1	Not Applicable (not required for Surface Mount Devices)	

Test group D: Die Fabrication Reliability Tests

Test #	Stress Test	Samples size/Lots	VND5E050ACJ-E Gold wires	VND5E050ACJ-E Copper wires
D1	Electromigration (EM)	Only for new technology. Data available to the user upon request	Covered by VND5E050AJ-E Gold wires	Not requested
D2	Time Dependent Dielectric Breakdown (TDDB)			
D3	Hot Carrier Injection (HCI)			
D4	Negative Bias Temperature Instability (NBTI)			
D5	Stress Migration (SM)			

Test group E: Electrical Verification Tests

Test #	Stress Test	Samples size/Lots	VND5E050ACJ-E Gold wires	VND5E050ACJ-E Copper wires
E2	ESD Human Body Model (HBM)	1 lot	1 lot	Not requested
	ESD Machine Model (MM)	1 lot	Not performed, as per AEC-Q100 at least one of HBM and MM test models must be performed	
E3	ESD Charge Device Model (CDM)	1 lot	1 lot	Not requested
E4	Latch Up (LU)	1 lot	1 lot	Not requested
E5	Electrical Distributions (ED)	30/3	Covered by VND5E050AJ-E Gold wires	Covered by VND5E050AJ-E Copper wires
E7	Characterization (CHAR)	1 lot	3 lots	Covered by VND5E050AJ-E Copper wires
E8	Electrothermally Induced Gate Leakage (GL)	6/1	1 lot	Not requested
E9	Electromagnetic Compatibility (EMC)	1 lot	1 lot	Not requested
E10	Short Circuit Characterization (SC)	10/3	3 lots	3 lots

Test group F: Defects Screening Tests

Test #	Stress Test	Samples size/Lots	VND5E050ACJ-E Gold wires	VND5E050ACJ-E Copper wires	
F1	Process Average Testing (PAT)	To be implemented after Q100 qualification on production lots			
F2	Statistical Bin/Yield Analysis (SBA)				

Test group G: Cavity Package Integrity Tests

Test #	Stress Test	Samples size/Lots	VND5E050ACJ-E Gold wires	VND5E050ACJ-E Copper wires	
G1	Mechanical Shock (MS)		Not Applicable (not for plastic packaged devices)		
G2	Variable Frequency Vibration (VFV)				
G3	Constant Acceleration (CA)				
G4	Gross/Fine Leak (GFL)				
G5	Package Drop (DROP)				
G6	Lid Torque (LT)				
G7	Die Shear (DS)				
G8	Internal Water Vapor (IWV)				

Public Products List

PCN Title : VND5E050Axx, VND5E050Mxx : Thermal Shutdown Improvement
PCN Reference : APG-ABD/13/8119
PCN Created on : 23-SEP-2013

Subject : Public Products List

Dear Customer,

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

ST COMMERCIAL PRODUCT

VND5E050AJ-E	VND5E050AJTR-E	VND5E050AK-E
VND5E050AKTR-E	VND5E050MJ-E	VND5E050MJTR-E
VND5E050MK-E	VND5E050MKTR-E	

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