# Reliability Evaluation Report

***On***

*M02 VIPOWER Transfer from CT6 to AMK6*

*TV: VN330SP-E*

| General Information | |
|---|---|
| **Product Line** | VN3301 |
| **Product Description** | Quad high-side smart power solid state-relay |
| **P/N** | VN330SP-E |
| **Product Group** | AMG |
| **Product division** | IND. & POWER CONV. |
| **Package** | PowerSO-10 |
| **Silicon Process technology** | VIP - M02 |

| Locations | |
|---|---|
| **Wafer fab** | Singapore 6 |
| **Assembly plant** | MUAR B/E |
| **Reliability Lab** | AMG Catania Reliability Lab |
| **Reliability assessment** | Pass |

## DOCUMENT INFORMATION

| Version | Date | Pages | Prepared by | Approved by | Comment |
|---|---|---|---|---|---|
| 1.0 | Oct-2016 | 6 | Vito Gisabella<br>Alfio Riciputo | Giovanni Presti | |

# TABLE OF CONTENTS

# 1 APPLICABLE AND REFERENCE DOCUMENTS

| Document reference | Short description |
|---|---|
| **JESD47** | Stress-Test-Driven Qualification of Integrated Circuits |

# 2 GLOSSARY

| | |
|---|---|
| **DUT** | Device Under Test |
| **SS** | Sample Size |

# 3 RELIABILITY EVALUATION OVERVIEW

The VN330SP-E is a monolithic device made using STMicroelectronics VIPower technology, intended for driving four indipendent resistive or inductive loads, with one side connected to ground.

## 3.1 Objectives

M02 VIPOWER transfer from CT6 to Singapore 6.

The Reliability verification will be performed by TVs.

The present report is related to the 1st Lot of TV VN33 line.

### 3.1.1 Evaluation Plan

The evaluation plan will includes the following TVs:

| Test Vehicle (line) | Diffusion Lot | Assy Lot | Package | FE Tech | Comment |
|---|---|---|---|---|---|
| VN33 | Singapore Ang Mo Kio | MUAR B/E | PowerSO-10 | VIP M02 | 1st Lot |
| VN34 | Singapore Ang Mo Kio | MUAR B/E | | VIP M02 | 2nd Lot |
| VN33 | Singapore Ang Mo Kio | MUAR B/E | | VIP M02 | 3rd Lot |

## 3.2 Conclusion

Qualification Plan requirements have been fulfilled without exception. It is stressed that 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 ruggedness of the products and safe operation, which is consequently expected during their lifetime.

# 4 DEVICE CHARACTERISTICS

## 4.1 Device description

The VN330SP-E is a monolithic device made using STMicroelectronics VIPower technology, intended for driving four indipendent resistive or inductive loads, with one side connected to ground. Active current limitation avoids dropping the system power supply in case of shorted load. Built-in thermal shut-down protects the chip from overtemperature and short circuit. The open drain diagnostic output indicates overtemperature conditions.

## 4.2 Construction note

| | **VN330SP-E** |
|---|---|
| **Wafer/Die fab. information** | |
| Wafer fab manufacturing location | Singapore 6 Ang Mo Kio |
| Technology | VIP M02 |
| Die finishing back side | Ti/NiV/Au |
| Die size | 5400 x 4500 micron |
| Passivation type | SiN (nitride) |
| **Wafer Testing (EWS) information** | |
| Electrical testing manufacturing location | Ang Mo Kio EWS |
| Tester | QT200 |
| **Assembly information** | |
| Assembly site | MUAR |
| Package description | PowerSO-10 |
| Molding compound | Epoxy |
| Frame material | FRAME PSO-10 4riv Flo SpAg |
| Die attach material | PREFORM |
| Wires bonding materials/diameters | WIRE Au D1.3 |
| **Final testing information** | |
| Testing location | MUAR B/E |
| Tester | QT200 |

# 5 TESTS RESULTS SUMMARY

## 5.1 Test vehicle

| Lot | Technical Code | Package | Comments |
|---|---|---|---|
| LOT # 1 | AMIY*VN33DY6 | PowerSO-10 | |

## 5.2 Test plan and results summary

VN330SP-E

| Test | PC | Std ref. | Conditions (*) | SS | Steps | Failure/SS | Note |
|---|---|---|---|---|---|---|---|
| **Die Oriented Tests** | | | | | | | |
| HTS | N | JESD22 A-103 | Ta = 150°C | | 168 H | 0/45 | |
| | | | | | 500 H | 0/45 | |
| | | | | | 1000 H | 0/45 | |
| HTOL | N | JESD22 A-108 | Ta = 125°C Vcc1=+28V Vcc2=+5V | | 168 H | 0/77 | |
| | | | | | 500 H | 0/77 | |
| | | | | | 1000 H | 0/77 | |
| **Package Oriented Tests** | | | | | | | |
| PC | | JESD22 A-113 | Drying 24 H @ 125°C Store 40 H @ Ta=60°C Rh=60% Oven Reflow @ Tpeak=250°C 3 times | | Final | Pass | Go no go |
| AC | Y | JESD22 A-102 | Pa=2Atm / Ta=121°C | | 96H | 0/25 | |
| | | | | | 168 H | 0/25 | Eng. evaluation |
| TC | Y | JESD22 A-104 | Ta = -65°C to 150°C | | 100 cy | 0/25 | |
| | | | | | 200 cy | 0/25 | |
| | | | | | 500 cy | 0/25 | |
| THB | Y | JESD22 A-101 | Ta = 85°C, RH = 85% Vcc1=+24V | | 168 H | 0/25 | |
| | | | | | 500 H | 0/25 | |
| | | | | | 1000 H | 0/25 | |
| (*) all samples have been assembled on dedicated PCB | | | | | | | |
| **Other Tests** | | | | | | | |
| ESD | N | ANSI/ESDA/JEDEC JS001-2014 | HBM | 3 | +/- 2000V | 0/3 | |
| | | ANSI/ESDA/JEDEC JS002-2014 | CDM | 3 | +/-500V All pins | 0/3 | |
| | | | CDM | 3 | +/-750V Corner Pins | 0/3 | |
| | | EIA/JESD78E | LU | 6 | +/-100mA | 0/6 | |

# 6 ANNEXES

## 6.1 Tests Description

| Test name | Description | Purpose |
|---|---|---|
| **Die Oriented** | | |
| **HTSL**<br>High Temperature Storage Life | The device is stored in unbiased condition at the max. temperature allowed by the package materials, sometimes higher than the max. operative temperature. | To investigate the failure mechanisms activated by high temperature, typically wire-bonds solder joint ageing, data retention faults, metal stress-voiding. |
| **HTOL**<br>High Temperature Operative Life | The device is stressed in static or dynamic configuration, approaching the operative max. absolute ratings in terms of junction temperature and bias condition. | 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. The typical failure modes are related to, silicon degradation, wire-bonds degradation, oxide faults |
| **Package Oriented** | | |
| **PC**<br>Preconditioning | The device is submitted to a typical temperature profile used for surface mounting devices, after controlled moisture absorption. | As stand-alone test: to investigate the moisture sensitivity level.<br>As preconditioning before other reliability tests: to verify that the surface mounting stress does not impact on the subsequent reliability performance.<br>The typical failure modes are "pop corn" effect and delamination. |
| **AC**<br>Auto Clave (Pressure Pot) | The device is stored in saturated steam, at fixed and controlled conditions of pressure and temperature. | To investigate corrosion phenomena affecting die or package materials, related to chemical contamination and package hermeticity. |
| **TC**<br>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. |
| **THB** | 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. |
| **Other** | | |
| **ESD**<br>Electro Static Discharge | The device is submitted to a high voltage peak on all his pins simulating ESD stress according to different simulation models.<br>**CDM:** Charged Device Model<br>**HBM**: Human Body Model | To classify the device according to his susceptibility to damage or degradation by exposure to electrostatic discharge. |
| **LU**<br>Latch-Up | The device is submitted to a direct current forced/sunk into the input/output pins. Removing the direct current no change in the supply current must be observed | To verify the presence of bulk parasitic effect inducing latch-up. |

# Reliability Evaluation Report

***On***

*M02 VIPOWER Transfer from CT6 to AMK6*

*TV: VN340SP-E*

| General Information | |
|---|---|
| **Product Line** | VN3401 |
| **Product Description** | Quad high-side smart power solid state-relay |
| **P/N** | VN340SP-E |
| **Product Group** | AMG |
| **Product division** | IND. & POWER CONV. |
| **Package** | PowerSO-10 |
| **Silicon Process technology** | VIP-M02 |

| Locations | |
|---|---|
| **Wafer fab** | Singapore Ang Mo Kio |
| **Assembly plant** | MUAR |
| **Reliability Lab** | Catania Reliability Lab |
| **Reliability assessment** | Pass |

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# 2 GLOSSARY

| | |
|---|---|
| **DUT** | Device Under Test |
| **SS** | Sample Size |

# 3 RELIABILITY EVALUATION OVERVIEW

The VN340SP-E is a monolithic device developed using ST VIPower™ technology, intended to drive four independent resistive or inductive loads with one side connected to ground.

## 3.1 Objectives

Tranfer M02 VIPOWER from CT6 to Singapore Ang Mo Kio.

The Reliability verification will be performed by TVs.

The present report is related to the 2nd Lot of TV VN34 line.

## 3.2 Evaluation Plan

The evaluation plan will includes the following TVs:

| Test Vehicle (line) | Diffusion Lot | Assy Lot | Package | FE Tech | Comment |
|---|---|---|---|---|---|
| VN33 | Singapore Ang Mo Kio | MUAR B/E | PowerSO-10 | VIP M02 | 1st Lot |
| VN34 | Singapore Ang Mo Kio | MUAR B/E | | VIP M02 | 2nd Lot |
| VN33 | Singapore Ang Mo Kio | MUAR B/E | | VIP M02 | 3rd Lot |

## 3.3 Conclusion

Qualification Plan requirements have been fulfilled without exception. It is stressed that 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 ruggedness of the products and safe operation, which is consequently expected during their lifetime.

# 4 DEVICE CHARACTERISTICS

## 4.1 Device description

The VN340SP-E is a monolithic device developed using ST VIPower™ technology, intended to drive four independent resistive or inductive loads with one side connected to ground. Active current limitation avoids dropping the system power supply in case of shorted load. Built-in thermal shutdown protects the chip from overtemperature and short-circuit. The open drain diagnostic output indicates overtemperature conditions. Each I/O is pulled down when the overtemperature condition of the relative channel is verified.

## 4.2 Construction note

| | **VN340SP-E** |
|---|---|
| **Wafer/Die fab. information** | |
| Wafer fab manufacturing location | SINGAPORE Ang Mo Kio |
| Technology | VIP M02 |
| Die finishing back side | Ti/NiV/Au |
| Die size | 5070 x 4390 micron |
| Passivation type | SiN (nitride) |
| **Wafer Testing (EWS) information** | |
| Electrical testing manufacturing location | Ang Mo Kio EWS |
| Tester | QT200 |
| **Assembly information** | |
| Assembly site | MUAR B/E |
| Package description | PowerSO-10 |
| Molding compound | Epoxy |
| Frame material | FRAME PSO-10 4riv Flo SpAg |
| Die attach material | PREFORM |
| Wires bonding materials/diameters | WIRE Au D1.3 |
| **Final testing information** | |
| Testing location | MUAR B/E |
| Tester | QT200 |

# 5 TESTS RESULTS SUMMARY

## 5.1 Test vehicle

| Lot | Technical Code | Package | Comments |
|---|---|---|---|
| **Lot #**1 | AMIY*VN34EY6 | PowerSO-10 | |

## 5.2 Test plan and results summary

VN340SP-E

| Test | PC | Std ref. | Conditions | SS | Steps | Failure/SS | Note |
|---|---|---|---|---|---|---|---|
| **Die Oriented Tests** | | | | | | | |
| HTS | N | JESD22 A-103 | Ta = 150°C | | 168 H | 0/45 | |
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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 :*** Additional wafer fab in ST Ang Mo Kio (Singapore) for VIPOWER M02 products

***PCN Reference :*** AMG/17/10123

***Subject :*** Public Products List

Dear Customer,

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

| | | |
|---|---|---|
| VN340SP-33-E | VN340SP-E | VN540SP-E |
| VN540SPTR-E | VN330SP-E | VN340SPTR-33-E |
| VN540-E | VN340SPTR-E | VN330SPTR-E |

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