# PRODUCT / PROCESS CHANGE NOTIFICATION

| 1. PCN basic data | |
|---|---|
| 1.1 Company | STMicroelectronics International N.V |
| 1.2 PCN No. | ADG/23/14357 |
| 1.3 Title of PCN | Molding compound replacement for SOD123Flat & SOD128Flat in subcontractor in Malaysia for Rectifiers and Protection diodes |
| 1.4 Product Category | STPSxxxxZF / STPSxxxxZFY<br>STTHxxxxZF / STTHxxxxZFY<br>STPSTxxxxZF / STPSTxxxxZFY<br><br>STPSxxxxAF / STPSxxxxAFY<br>STPSTxxxxAF / STPSTxxxxAFY<br>STTHxxxxAF / STTHxxxxAFY<br>SMxFxxAY |
| 1.5 Issue date | 2023-12-08 |

| 2. PCN Team | |
|---|---|
| 2.1 Contact supplier | |
| 2.1.1 Name | NEMETH KRISZTINA |
| 2.1.2 Phone | +49 89460062210 |
| 2.1.3 Email | krisztina.nemeth@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 |
| Materials | New direct material part number (same supplier, different supplier or new supplier), Mold compound | Subcontractor in Malaysia |

| 4. Description of change | | |
|---|---|---|
| | Old | New |
| 4.1 Description | Resin supply by Kyocera Singapore | Resin supply by Kyocera Japan |
| 4.2 Anticipated Impact on form,fit, function, quality, reliability or processability? | No | |

| 5. Reason / motivation for change | |
|---|---|
| 5.1 Motivation | Molding compound discontinuation from current resin supplier. |
| 5.2 Customer Benefit | SERVICE CONTINUITY |

| 6. Marking of parts / traceability of change | |
|---|---|
| 6.1 Description | Traceability of the change will be ensured by Finished Good/Type print on carton labels.<br>New Finished Good ending with “J” |

| 7. Timing / schedule | |
|---|---|
| 7.1 Date of qualification results | 2023-11-28 |
| 7.2 Intended start of delivery | 2024-04-26 |
| 7.3 Qualification sample available? | Upon Request |

| 8. Qualification / Validation | | | |
|---|---|---|---|
| 8.1 Description | 14357 Qualification Reports.pdf | | |
| 8.2 Qualification report and qualification results | Available (see attachment) | Issue Date | 2023-12-08 |

| 9. Attachments (additional documentations) |
|---|
| 14357 Public product.pdf<br>14357 PCN SOD123Flat & SOD128Flat new molding compound at subco.pdf<br>14357 Qualification Reports.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 |
| | STPS2H100ZF | |
| | STPS3H100AF | |
| | STTH3R02AFY | |

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# Public Products List

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***PCN Title :*** Molding compound replacement for SOD123Flat & SOD128Flat in subcontractor in Malaysia for Rectifiers and Protection diodes

***PCN Reference :*** ADG/23/14357

***Subject :*** Public Products List

Dear Customer,

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

| | | |
|---|---|---|
| SM6F6.5AY | STPS5H100AF | STPST1H100AFY |
| STTH1R06AF | STPST1H100ZFY | SM6F28AY |
| SM6F12AY | SM6F36AY | SM6F20AY |
| STPS2L40ZFY | SM6F24AY | STPS2H100ZFY |
| SM6F14AY | SM6F26AY | SM6F5.0AY |
| STPST2H100ZFY | STPST2H100AF | SM6F30AY |
| STTH1R02ZF | STPS2H100ZF | STPS360AFY |
| STPST2H100AFY | SM6F8.5AY | SM6F6.0AY |
| STPS2L60ZFY | SM6F16AY | STTH1R02ZFY |
| STPST5H100AFY | STPST3H100AF | STPS2H100AFY |
| STTH1R06AFY | STPS1L60ZFY | SM6F18AY |
| STPS1L40ZFY | SM6F33AY | SM6F23AY |
| STPS1L40ZF | SM6F13AY | SM6F15AY |
| SM6F31AY | STTH3R02AFY | STPST1H100ZF |
| STPS1L60ZF | STPS360AF | STPST3H100AFY |
| STPST5H100AF | STPS3H100AF | STTH2R02AFY |
| STPS3H100AFY | STPST2H100ZF | SM6F11AY |
| STPST1H100AF | SM6F10AY | SM6F22AY |
| STPS5H100AFY | | |

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# Qualification Report

*Molding compound replacement for SOD123Flat & SOD128Flat packages in Malaysia subcontractor for Rectifiers and Protection diodes – Automotive grade*

| General Information | |
|---|---|
| **Product Line** | *Rectifiers & Protection* |
| **Product Description** | *Ultrafast, Power Schottky & Power Schottky Trench Diodes, TVS* |
| **Product perimeter** | *STPSxxxxZFY / STTHxxxxZFY*<br>*STPSTxxxxZFY*<br>*STPSxxxxAFY / STPSTxxxxAFY*<br>*STTHxxxxAFY / SMxFxxAY* |
| **Product Group** | *ADG* |
| **Product division** | *Discrete & Filter* |
| **Package** | *SOD123-FLAT, SOD128-FLAT* |
| **Maturity level step** | *30* |

| Locations | |
|---|---|
| **Wafer fab** | *Tours 6 – France*<br>*Ang Mo Kio - Singapore* |
| **Assembly plant** | *Subcontractor 996I – Malaysia* |
| **Reliability Lab** | *ST TOURS - FRANCE* |
| **Reliability assessment** | *PASS* |

## DOCUMENT INFORMATION

| Version | Date | Pages | Prepared by | Approved by | Comments |
|---|---|---|---|---|---|
| 1.0 | 23-Nov-2023 | 20 | Yann TURIN | Christophe Goin<br>Digitally signed by Christophe Goin<br>Date: 2023.11.23 14:59:36 +01'00' | 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 |
| **AEC-Q005** | Pb-Free Test Requirements |
| **AEC-Q101 Rev E** | Failure Mechanism Based Stress Test Qualification for Discrete Semiconductors in Automotive Applications |

# 2 GLOSSARY

| | |
|---|---|
| **SS** | Sample Size |
| **PC** | Pre-Conditioning |
| **HTRB** | High Temperature Reverse Bias |
| **TC** | Temperature Cycling |
| **H3TRB** | High Humidity High Temperature Reverse Bias |
| **IOLT** | Intermittent Operating Life Test |
| **UHAST** | Unbiased Highly Accelerated Stress Test |
| **GD** | Generic Data |
| **SD** | Solderability test |
| **MSL** | Moisture Sensitivity Level |
| **WG** | Whiskers Growth |
| **Tj** | Junction Temperature |
| **BS** | Bond Shear |
| **WBS** | Wire Bond Strength |
| **RSH** | Resistance to Soldering Heat |
| **DPA** | Destructive Physical Analysis (after TC and THB) |

# 3 RELIABILITY EVALUATION OVERVIEW

## 3.1 Objectives

The objective of this report is to qualify new molding compound source for SOD123-FLAT and SOD128-FLAT packages.

The involved products are listed in the table here below:

| Product | Description | Package | Assembly Location |
|---|---|---|---|
| SM6F10AY<br>SM6F11AY<br>SM6F12AY<br>SM6F13AY<br>SM6F14AY<br>SM6F15AY<br>SM6F16AY<br>SM6F18AY<br>SM6F20AY<br>SM6F22AY<br>SM6F23AY<br>SM6F24AY<br>SM6F26AY<br>SM6F28AY<br>SM6F30AY<br>SM6F31AY<br>SM6F33AY<br>SM6F36AY<br>SM6F5.0AY<br>SM6F6.0AY<br>SM6F6.5AY<br>SM6F8.5AY | TVS | SOD128-FLAT | Subcontractor 996I – Malaysia |
| STPS1L40ZFY<br>STPS1L60ZFY<br>STPS2H100ZFY<br>STPS2L40ZFY<br>STPS2L60ZFY | Power Schottky | SOD123-FLAT | |
| STPS2H100AFY<br>STPS360AFY<br>STPS3H100AFY<br>STPS5H100AFY | | SOD128-FLAT | |
| STPST1H100ZFY<br>STPST2H100ZFY | Power Schottky Trench | SOD123-FLAT | |
| STPST1H100AFY<br>STPST2H100AFY<br>STPST3H100AFY<br>STPST5H100AFY | | SOD128-FLAT | |
| STTH1R02ZFY<br>STTH1R02ZFY | Ultrafast | SOD123-FLAT | |
| STTH1R06AFY<br>STTH2R02AFY<br>STTH3R02AFY | | SOD128-FLAT | |

The reliability test methodology used follows the ST 0061692 & AEC Q101 Rev. E specifications.

The following reliability tests ensuing are:

- TC and IOLT (only for rectifiers) 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, UHAST to check the robustness to corrosion and the good package hermeticity.
- RSH, Solderability to check compatibility of package with customer assembly.
- WG to check lead-finishing quality.

For some tests, similarity methodology is used. See 5.2 “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

Refer to ST specification (some examples below):

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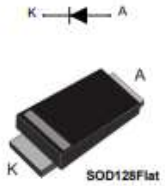
**STPST3H100-Y**

Datasheet

Automotive 100 V - 3 A power Schottky trench diode




### Features

- AEC-Q101 qualified
- PPAP capable
- ST trench process
- High junction temperature capability
- Low forward voltage drop
- Low recovery charges
- Reduces conduction, reverse and switching losses
- Flat package
- ECOPACK2 compliant

### Applications

- DC/DC converter
- Auxiliary power supply
- High switching frequency converter
- Flyback topology
- Reverse polarity protection
- Freewheeling function

### Description

This 3 A, 100 V rectifier is based on ST trench technology that achieves the best in class $V_F/I_R$ trade-off for a given silicon surface.

Integrated in flat packages, this STPST3H100-Y trench device is intended to be used in high frequency miniature switched mode power supplies such as adaptors. It is also an ideal candidate for auxiliary power supply in telecom, server, lighting or smart metering and can be the perfect companion device to our VIPer products.

| Product status link |
|---|
| STPST3H100-Y |

| Product summary | |
|---|---|
| $I_{F(AV)}$ | 3 A |
| $V_{RRM}$ | 100 V |
| $T_j$ (max.) | 175 °C |
| $V_F$ (typ.) | 0.600 V |

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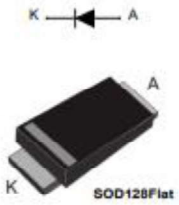
# STTH1R06AFY

Datasheet

## Automotive 600 V, 1 A, turbo 2 ultrafast rectifier




## Features

- AEC-Q101 qualified
- Ultrafast recovery
- $V_{RRM}$ 600 V up to -40 °C
- Low power losses
- High surge capability
- Low leakage current
- High junction temperature
- PPAP capable
- ECOPACK®2 compliant component

## Applications

- Reverse polarity protection
- Clamping function
- Boost diode
- PFC

## Description

The STTH1R06AFY is an ultrafast recovery power rectifier dedicated to energy recovery in automotive application housed in SOD128Flat to improve space saving.

It is especially designed for clamping function in energy recovery block.

The compromise between forward voltage drop and recovery time offers optimized performance.

| Product status |
|---|
| STTH1R06AFY |

| Product summary | |
|---|---|
| $I_{F(AV)}$ | 1 A |
| $V_{RRM}$ | 600 V |
| $t_{rr}$ | 30 ns |
| $T_j$ | 175 °C |
| $V_{F(typ.)}$ | 1.08 V |

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# SM6FxxAY

Datasheet

## Automotive 600 W TVS in SOD128 Flat


**SOD128 Flat**


**Unidirectional**

| Product status link | |
|---|---|
| SM6FY | SM6F5.0AY, SM6F6.0AY, SM6F6.5AY, SM6F8.5AY, SM6F10AY, SM6F11AY, SM6F13AY, SM6F12AY, SM6F14AY, SM6F15AY, SM6F16AY, SM6F18AY, SM6F20AY, SM6F22AY, SM6F23AY, SM6F24AY, SM6F26AY, SM6F28AY, SM6F30AY, SM6F31AY, SM6F33AY, SM6F36AY |

## Features

- AEC-Q101 qualified
- Peak pulse power: 600 W (10/1000 µs) and 4 kW (8/20 µs)
- Stand-off voltage range from 5 V to 36 V
- Unidirectional type
- Low leakage current: 0.2 µA at 25 °C and 1 µA at 85 °C
- Operating $T_j$ max: 175 °C
- High power capability at 175 °C ($T_j$ max.) up to 240 W (10/1000 µs)
- Lead finishing: matte tin platting

## 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
- ISO10605, IEC 61000-4-2, C= 150 pF - R = 330 Ω exceeds level 4:
  - 30 kV (air discharge)
  - 30 kV (contact discharge)
- ISO10605 - C = 330 pF, R = 330 Ω exceeds level 4:
  - 30 kV (air discharge)
  - 30 kV (contact discharge)
- ISO7637-2 (Not applicable to parts with stand-off voltage lower than battery voltage)
  - Pulse1: $V_S$ = -150 V
  - Pulse 2a: $V_S$ = +112 V
  - Pulse 3a: $V_S$ = -220 V
  - Pulse 3b: $V_S$ = +150 V

## Description

The SM6FY series are designed to protect sensitive automotive circuits against surges defined in ISO 7637-2 and against electrostatic discharges according to ISO 10605.

The Planar technology makes it compatible with high-end circuits where low leakage current and high junction temperature are required to provide long term reliability and stability.

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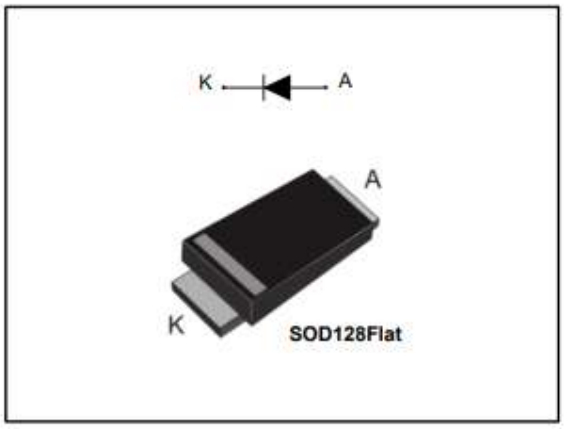
# STPS5H100AFY

## Automotive high voltage power Schottky rectifier

Datasheet - production data




## Description

This high voltage Schottky barrier rectifier device is packaged in SOD128Flat and designed for high frequency miniature switched mode power supplies and for board DC to DC converters for automotive applications.

**Table 1: Device summary**

| Symbol | Value |
|---|---|
| $I_{F(AV)}$ | 5 A |
| $V_{RRM}$ | 100 V |
| $T_j$(max.) | 175 °C |
| $V_F$(typ.) | 0.51 V |

## Features

- Negligible switching losses
- High junction temperature capability
- Low leakage current
- Good trade-off between leakage current and forward voltage drop
- Avalanche specification
- ECOPACK® compliant component
- AEC-Q101
- PPAP capable
- $V_{RRM}$ guaranteed from -40 to +175 °C

## 4.2 Construction Note

| | *STPSxxxxZFY - STPSxxxxAFY* |
|---|---|
| **Wafer/Die fab. information** | |
| Wafer fab manufacturing location | Ang Mo Kio - Singapore |
| Technology / Process family | Power Schottky |
| **Wafer Testing (EWS) information** | |
| Electrical testing manufacturing location | Ang Mo Kio - Singapore |
| **Assembly information** | |
| Assembly site | Subcontractor – Malaysia (996I) |
| Package description | SOD123-Flat, SOD128-Flat |
| Molding compound | ECOPACK®2 |
| Lead finishing | Lead free (Pure Tin) |
| **Final testing information** | |
| Testing location | Subcontractor – Malaysia (996I) |

| | *STTHxxxxZFY - STTHxxxxAFY* |
|---|---|
| **Wafer/Die fab. information** | |
| Wafer fab manufacturing location | Tours - France |
| Technology / Process family | Rectifiers |
| **Wafer Testing (EWS) information** | |
| Electrical testing manufacturing location | Tours - France |
| **Assembly information** | |
| Assembly site | Subcontractor – Malaysia (996I) |
| Package description | SOD123-Flat, SOD128-Flat |
| Molding compound | ECOPACK®2 |
| Lead finishing | Lead free (Pure Tin) |
| **Final testing information** | |
| Testing location | Subcontractor – Malaysia (996I) |

| | *STPSTxxxxZFY - STPSTxxxxAFY* |
|---|---|
| **Wafer/Die fab. information** | |
| Wafer fab manufacturing location | Ang Mo Kio - Singapore |
| Technology / Process family | Power Schottky Trench |
| **Wafer Testing (EWS) information** | |
| Electrical testing manufacturing location | Ang Mo Kio - Singapore |
| **Assembly information** | |
| Assembly site | Subcontractor – China (998G) |
| Package description | SOD123-Flat, SOD128-Flat |
| Molding compound | ECOPACK®2 |
| Lead finishing | Lead free (Pure Tin) |
| **Final testing information** | |
| Testing location | Subcontractor – China (998G) |

| | *SMxFxxAY* |
|---|---|
| **Wafer/Die fab. information** | |
| Wafer fab manufacturing location | Tours - France |
| Technology / Process family | TVS |
| **Wafer Testing (EWS) information** | |
| Electrical testing manufacturing location | Tours - France |
| **Assembly information** | |
| Assembly site | Subcontractor – Malaysia (996I) |
| Package description | SOD128-Flat |
| Molding compound | ECOPACK®2 |
| Lead finishing | Lead free (Pure Tin) |
| **Final testing information** | |
| Testing location | Subcontractor – Malaysia (996I) |

# 5 TESTS RESULTS SUMMARY

## 5.1 Test vehicles

| Lot # | Part Number | Package | Comments |
|---|---|---|---|
| L11 | STPST2H100ZF | SOD 123 | Qualification lot |
| L13 | STTH1R06AFY | SOD 128 | Qualification lot |
| L20 | SM6F36AY | SOD 128 | Qualification lot |
| L19 | STTH1R02ZFY | SOD 123 | Qualification lot |
| L15 | STPS2H100ZF | SOD 123 | Qualification lot |
| L17 | STPS5H100AFY | SOD 128 | Qualification lot |
| GD1 | Dummies | SOD 128 | Generic data for whiskers test |

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 | JESD22A-113 | All qualification parts tested per the requirements of the appropriate device specification | | As per targeted MSL<br>Not applicable for PTH and WLCSP without coating | X |
| MSL research | MSL | J-STD-020 | L20, L19, L17 | 90 | Not applicable for PTH and WLCSP without coating | X |
| 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 | All qualification parts tested per the requirements of the appropriate device specification | | | X |
| High Temperature Storage Life | HTSL | JESD22B-101 | | | Covered by HTRB | |
| Temperature Humidity Storage | THS | JESD22 A-118 | | | Covered by H3TRB | |
| High Temperature Gate Bias | HTGB | JESD22A-108 | | | Required for PowerMOSFET – IGBT only. | |
| High Temperature Reverse Bias | HTRB | JESD22A-108 | L13, L20, L11, L15 | 308 | | X |
| High Temperature Forward Bias | HTFB | JESD22A-108 | | | Not required, applicable only to LEDS | |
| High Temperature Operating Life Test | HTOL | JESD22A-108 | | | Covered by HTRB. | |
| Steady State Operational | SSOP | MIL-STD-750-1 M1038 Test B | | | Required for Voltage Regulator (Zener) only. | |
| AC blocking voltage | ACBV | MIL-STD-750-1 M1040 Test A | | | Required for Thyristor only. | |
| Temperature Cycling | TC | JESD22A-104 | L13, L20, L17, L15 | 308 | | 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. | |
| Wire Bond Integrity | WBI | MIL-STD-750 Method 2037 | | | For dissimilar metal bonding systems only | |
| Unbiased Highly Accelerated Stress Test | UHAST | JESD22A-118 | L20, L19, L17, L15 | 308 | | X |
| Autoclave | AC | JESD22A-102 | | | Not recommended | |
| Highly Accelerated Stress Test | HAST | JESD22A-110 | | | Covered by H3TRB | |
| High Humidity High Temperature Reverse Bias | H3TRB | JESD22A-101 | L11, L20, L19, L17, L15 | 385 | | X |
| High Temperature High Humidity Bias | HTHHB | JED22A-101 | | | Not required, LED only | |
| Intermittent Operational Life / Thermal Fatigue | IOL / TF | MIL-STD-750 Method 1037 | L13, L17, L15 | 231 | For power devices. Not required for Transient Voltage Suppressor (TVS) parts | X |
| Power and Temperature Cycle | PTC | JED22A-105 | | | Covered by IOL | |
| ESD Characterization | ESD HBM | AEC Q101-001 and 005 | | | For automotive products only See Annexe 6.1 | X |

| | | | | | | |
|---|---|---|---|---|---|---|
| Destructive Physical Analysis | DPA | AEC-Q101-004 Section 4 | L13, L19 | 4 | After H3TRB and TC. For automotive products only | X |
| Physical Dimension | PD | JESD22B-100 | GD | 60 | See Annexe 6.2 | X |
| 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) | L20, L17, L15 | 90 | Not applicable for SMD pitch < 0.5mm, package size > 5.5*12.5mm and die paddle > 2.5*3.5mm | X |
| Solderability | SD | J-STD-002 JESD22B102 | L13, L15 | 120 | | X |
| Thermal Resistance | TR | JESD24-3, 24-4, 24-6 as appropriate | L13, L20, L11 | 25 | Required in case of process change. See Annex 6.1 - RTH column | X |
| Wire Bond Strength | WBS | MIL-STD-750 Method 2037 | | | NA for products with clip | |
| Bond Shear | BS | AEC-Q101-003 | | | NA for products with clip | |
| 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 | GD1 | 45 | | X |
| Early Life Failure Rate | ELFR | JESD74 | | | Recommended for new techno development in case of identified failure mechanism | |
| Low Temperature Storage | LTS | JESD-22 A119: 209 | | | AQG324 test for Modules | |
| Thermal shock test | TST | JESD22-A104 | | | AQG324 test for Modules | |
| Power Cycling (seconds) | PCsec | MIL-STD750-1 Method1037 | | | AQG324 test for Modules | |
| Power Cycling (minutes) | PCmin | MIL-STD750-1 Method1037 | | | AQG324 test for Modules | |
| Mechanical shock | MS | IEC 600068-2-27 | | | AQG324 test for Modules | |
| Vibration | V | IEC60068-2-6 | | | AQG324 test for Modules | |
| Repetitive Surge | RS | Internal Specification | | | Only for TVS products | |

## 5.3 Results summary

| Test | PC | Std ref. | Conditions | Total | Steps | Results/Lot Fail/S.S. | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Lot 11 | Lot 19 | Lot 15 | Lot 13 | Lot 20 | Lot 17 |
| Parametric Verifications | | ST datasheet | Over part temperature range | | - | Refer to paragraph 6.1 in Annexes | | | | | |
| External Visual Inspection | | JESD22 B-101 | - | | - | All qualification parts submitted for testing passed External & Visual inspection during manufacturing process | | | | | |
| Pre and Post Electrical Test | | ST datasheet | $I_R$, $V_F$ parameters following product datasheet | 1885 | - | 0/1885 | | | | | |
| PC | | JESD22A-113 | Drying 24hrs; 125°C Storage 168hrs; 85°C;85%RH IR reflow 3 times | 1412 | - | 0/1412 | | | | | |
| MSL1 research | Y | J-STD-020 | MSL=1, Reflow=3 Temperature=85°C Humidity (HR)=85% | 90 | - | | 0/30 | | | 0/30 | 0/30 |
| HTRB | N | JESD22-A108/MIL-STD-750-1 M1038 Method A | Junction Temperature=130°C Temperature=115°C Voltage=80V | 308 | 1000h | 0/77 | | 0/77 | | | |
| | | | Junction Temperature=175°C Temperature=170°C Voltage=600V | | 1000h | | | | 0/77 | | |
| | | | Junction Temperature=175°C Temperature=170°C Voltage=36V | | 1000h | | | | | 0/77 | |
| TC | Y | JESD22-A104 | Frequency (cy/h)=2cy/h Temperature (high)=150°C Temperature (low)=-55°C | 308 | 1000cy | | | 0/77 | 0/77 | 0/77 | 0/77 |
| RSH | Y | JESD22A-111 (SMD) / JESD22B-106 (PTH) | Temperature=260°C Time (on)=10s | 90 | - | | | 0/30 | | 0/30 | 0/30 |
| H3TRB | Y | JESD22-A101 | Humidity (HR)=85% Temperature=85°C Voltage=80V | 385 | 1000h | 0/77 | | 0/77 | | | 0/77 |
| | | | Humidity (HR)=85% Temperature=85°C Voltage=100V | | 1000h | | 0/77 | | | | |
| | | | Humidity (HR)=85% Temperature=85°C Voltage=36V | | 1000h | | | | | 0/77 | |
| uHAST | Y | JESD22 A-118 | Humidity (HR)=85% Pressure=2.3bar Temperature=130°C | 308 | 96h | | 0/77 | 0/77 | | 0/77 | 0/77 |
| IOLT | Y | MIL-STD 750 Method 1037 | Delta Tj=125°C Intensity (If)=0.8A Time (off)=120s Time (on)=120s | 231 | 500h | | | | 0/77 | | |
| | | | Delta Tj=125°C Intensity (If)=1.45A Time (off)=120s Time (on)=120s | | 500h | | | 0/77 | | | |
| | | | Delta Tj=125°C Intensity (If)=2.1A Time (off)=120s Time (on)=120s | | 500h | | | | | | 0/77 |
| DPA | Y | ST 0060102 AEC Q101 | Post TC or H3TRB | 4 | - | | 0/2 | | 0/2 | | |

| Test | PC | Std ref. | Conditions | Total | Steps | Results/Lot Fail/S.S. | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Lot 11 | Lot 19 | Lot 15 | Lot 13 | Lot 20 | Lot 17 |
| SD | N | J-STD-002 | Dry Aging=16Hrs<br>Metal (solder)=SnPb<br>No Data Dream=1<br>No Elec Measurement=1<br>Temperature=220°C | 120 | Visual Inspection | | | 0/15 | 0/15 | | |
| | | | Metal (solder)=SnPb<br>No Data Dream=1<br>No Elec Measurement=1<br>Temperature=220°C<br>Wet Aging=8Hrs | | Visual Inspection | | | 0/15 | 0/15 | | |
| | | | Dry Aging=16Hrs<br>Metal (solder)=SnAgCu<br>No Data Dream=1<br>No Elec Measurement=1<br>Temperature=245°C | | Visual Inspection | | | 0/15 | 0/15 | | |
| | | | Metal (solder)=SnAgCu<br>No Data Dream=1<br>No Elec Measurement=1<br>Temperature=245°C<br>Wet Aging=8Hrs | | Visual Inspection | | | 0/15 | 0/15 | | |

| Test | PC | Std ref. | Conditions | Total | Steps | Results/Lot Fail/S.S. |
|---|---|---|---|---|---|---|
| | | | | | | GD 1 |
| Whiskers | N | JESD201 | No reflow<br>THS 30°C/60%RH | 45 | 4000h | 0/9 |
| | | | Reflow SnPb 215°C<br>THS 55°C/85%RH | | 4000h | 0/9 |
| | | | Reflow SnPb 215°C<br>TC -40°C – 85°C | | 1500cy | 0/9 |
| | | | Reflow SnPb 260°C<br>THS 55°C/85%RH | | 4000h | 0/9 |
| | | | Reflow SnPb 260°C<br>TC -40°C – 85°C | | 1500cy | 0/9 |

# 6 ANNEXES

## 6.1 Parametric Verifications

- Results on STTH1R06AFY product:

| TEST | VR | VR | VR | IR | IR |
|---|---|---|---|---|---|
| EQUIPMENT | TESEC_AMK | | | | |
| Condition 1 | -40°C | 25°C | 150°C | 25°C | 150°C |
| Condition 2 | | | | VR=600V | VR=600V |
| Min. Datasheet | *600V* | *600V* | *600V* | | |
| Typ. Datasheet | | | | | *10uA* |
| Max. Datasheet | | | | *1uA* | *75uA* |
| Comments | | | | | |
| UNIT | V | V | V | nA | uA |
| N | 20 | 20 | 20 | 20 | 20 |
| Min | 646.000 | 677.100 | 738.500 | 0.000 | 2.514 |
| Max | 688.300 | 732.500 | 798.500 | 31.300 | 3.290 |
| Avg. | 672.345 | 714.925 | 779.625 | 3.506 | 2.873 |

| TEST | VF | VF | RTH(J-L) | ESD_HBM | ESD_CDM |
|---|---|---|---|---|---|
| EQUIPMENT | TESEC_AMK | | AMK_RTH_Phase12 | ESS6008 | ESD-CDM TEST SYSTEM |
| Condition 1 | 25°C | 150°C | | 25°C | 25°C |
| Condition 2 | IF=1A | IF=1A | | | |
| Min. Datasheet | | | | | |
| Typ. Datasheet | | *1.08V* | | | |
| Max. Datasheet | *1.9V* | *1.4V* | *24°C/W* | | |
| Comments | | | | AEC-Q101 | AEC-Q101 |
| UNIT | V | V | °C/W | KV | KV |
| N | 20 | 20 | 10 | 30 | 30 |
| Min | 1.374 | 1.028 | 14.900 | 4 | >1.0 |
| Max | 1.544 | 1.121 | 16.190 | 4 | >1.0 |
| Avg. | 1.477 | 1.086 | 15.651 | 4 | |

- Results on STPS2H100ZF product:

| TEST | VF | VF | VF | VF | IR | IR |
|---|---|---|---|---|---|---|
| EQUIPMENT | TESEC_AMK | | | | | |
| Condition 1 | 24°C | 24°C | 125°C | 125°C | 24°C | 125°C |
| Condition 2 | IF=2A | IF=4A | IF=2A | IF=4A | VR=100V | VR=100V |
| Min. Datasheet | | | | | | |
| Typ. Datasheet | | | *0.65V* | *0.75V* | | *0.2mA* |
| Max. Datasheet | *0.86V* | *0.96V* | *0.7V* | *0.83V* | *1uA* | *0.5mA* |
| Comments | | | | | | |
| UNIT | V | V | V | V | nA | uA |
| N | 20 | 20 | 20 | 20 | 20 | 20 |
| Min | 0.786 | 0.853 | 0.635 | 0.707 | 78.020 | 123.700 |
| Max | 0.791 | 0.861 | 0.642 | 0.716 | 126.600 | 170.300 |
| Avg. | 0.789 | 0.857 | 0.640 | 0.713 | 90.865 | 136.840 |

| TEST | VR | VR | VR | RTH(J-L) | ESD_HBM | ESD_CDM |
|---|---|---|---|---|---|---|
| EQUIPMENT | TESEC_AMK | | | AMK_RTH_Phase12 | ESS6008 | ESD-CDM TEST SYSTEM |
| Condition 1 | -40°C | 24°C | 125°C | | 25°C | 25°C |
| Condition 2 | | | | | | |
| Min. Datasheet | *100V* | *100V* | *100V* | | | |
| Typ. Datasheet | | | | | | |
| Max. Datasheet | | | | *20°C/W* | | |
| Comments | | | | | AEC-Q101 | AEC-Q101 |
| UNIT | V | V | V | °C/W | KV | KV |
| N | 20 | 20 | 20 | 10 | 30 | 30 |
| Min | 118.500 | 125.700 | 137.700 | 13.180 | 6 | >1.0 |
| Max | 120.300 | 127.300 | 139.500 | 15.680 | 6 | >1.0 |
| Avg. | 119.365 | 126.435 | 138.650 | 14.176 | 6 | |

- Results on SM6F36AY product:

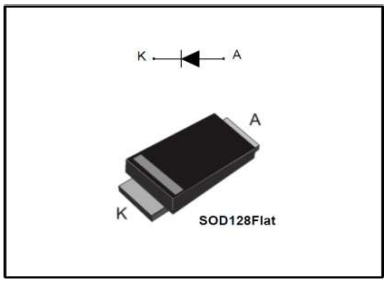
| TEST | IR | IR | VR | ESD_HBM | ESD_CDM | RTH(J-L) |
|---|---|---|---|---|---|---|
| EQUIPMENT | TSA_491 | | | ESS6008 | ESD-CDM TEST SYSTEM | RTH(PHASE12)_TEST417 |
| Condition 1 | 25°C | 85°C | 25°C | 25°C | 25°C | BARRE_ANALYSIS_TECH=S.U. |
| Condition 2 | VR=36V | VR=36V | IR=1000µA | | | BARRE_ST=S.U. |
| Min. Datasheet | | | *40V* | | | |
| Typ. Datasheet | | | *42.1V* | | | |
| Max. Datasheet | *200nA* | *1uA* | *44.2V* | | | |
| Comments | | | | AEC-Q101 | AEC-Q101 | |
| UNIT | nA | nA | V | KV | KV | °C/W |
| N | 20 | 20 | 20 | 30 | 30 | 5 |
| Min | 3.383 | 3.478 | 40.810 | >8.0 | >1.0 | 10.870 |
| Max | 83.790 | 7.295 | 42.710 | >8.0 | >1.0 | 12.490 |
| Avg. | 9.677 | 4.847 | 41.589 | | | 11.878 |

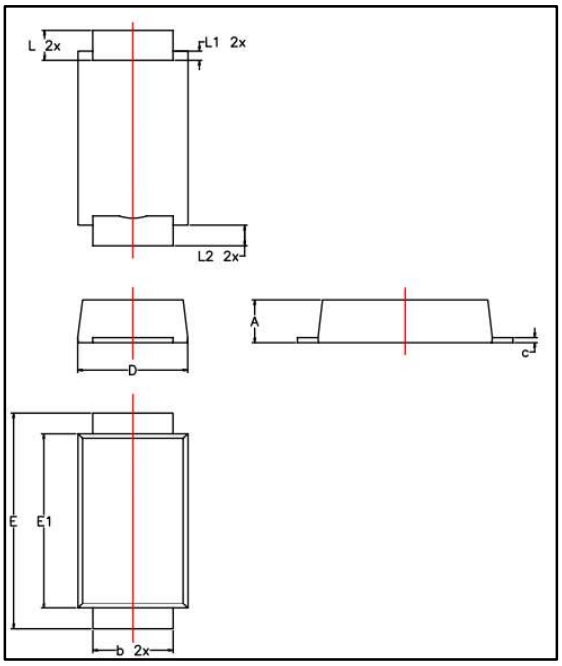
| TEST | VCL_10_1000 | RD | VCL_8_20 | RD | ALPHA_T |
|---|---|---|---|---|---|
| EQUIPMENT | VC6700 | TESTS_CALCULES | ARETI | TESTS_CALCULES | |
| Condition 1 | 25°C | 25°C | 25°C | 25°C | IR=1mA |
| Condition 2 | IPP=10.3A | IF1=5.2A | IPP=52A | IF1=26A | TJ1=25°C |
| Condition 3 | TP=1000us | IF2=10.3A | TP=20us | IF2=52A | TJ2=85°C |
| Condition 4 | TR=10us | VF1=10 - VCL_10_1000 V | TR=8us | VF1=16 - VCL_8_20 V | |
| Min. Datasheet | | | | | *1E-4/°C* |
| Typ. Datasheet | | | | | *1E-4/°C* |
| Max. Datasheet | *58.1V* | *1.35Ohm* | *76V* | *0.612Ohm* | *101E-4/°C* |
| Comments | | | | | |
| UNIT | V | Ohm | V | Ohm | 1E-4/°C |
| N | 10 | 10 | 10 | 10 | 20 |
| Min | 50.650 | 0.796 | 53.870 | 0.215 | 9.145 |
| Max | 53.540 | 1.061 | 54.400 | 0.246 | 9.445 |
| Avg. | 51.940 | 0.974 | 54.080 | 0.233 | 9.287 |

## 6.2 Physical Dimensions

# Dimensional report for SOD128 Flat package

| Ref. | Dimensions | |
|---|---|---|
| | Millimeters | |
| | Min. | Max. |
| A | 0.93 | 1.03 |
| b | 1.69 | 1.81 |
| c | 0.10 | 0.22 |
| D | 2.30 | 2.50 |
| E | 4.60 | 4.80 |
| E1 | 3.70 | 3.90 |
| L | 0.55 | 0.85 |
| L1 | 0.30 typ. | |
| L2 | 0.45 typ. | |

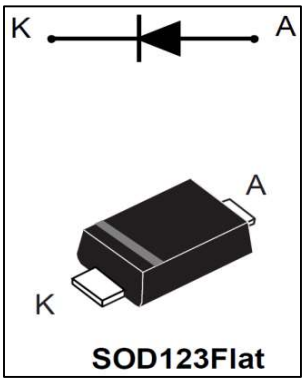


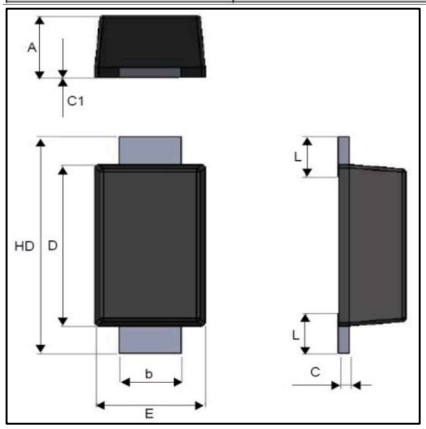




| Dimensions in mm | A | b | c | D | E | E1 | L | L1 | L2 |
|---|---|---|---|---|---|---|---|---|---|
| Measurement done on 30 units | | | | | | | | | |
| Min | 0.937 | 1.691 | 0.150 | 2.313 | 4.666 | 3.782 | 0.711 | 0.248 | 0.426 |
| Avg. | 0.955 | 1.712 | 0.160 | 2.401 | 4.685 | 3.817 | 0.743 | 0.277 | 0.466 |
| Max | 0.979 | 1.737 | 0.171 | 2.421 | 4.697 | 3.830 | 0.793 | 0.314 | 0.506 |
| LSL | 0.930 | 1.690 | 0.100 | 2.300 | 4.600 | 3.700 | 0.550 | | |
| Typ. | | | | | | | | 0.300 | 0.450 |
| USL | 1.030 | 1.810 | 0.220 | 2.500 | 4.800 | 3.900 | 0.850 | | |

# Dimensional report for SOD123 Flat package

| Ref. | Dimensions | | |
|---|---|---|---|
| | Millimeters | | |
| | Min. | Typ. | Max. |
| A | 0.86 | 0.98 | 1.10 |
| b | 0.80 | 0.90 | 1.00 |
| c | 0.08 | 0.15 | 0.25 |
| c1 | 0.00 | | 0.10 |
| D | 2.50 | 2.60 | 2.70 |
| E | 1.50 | 1.60 | 1.80 |
| HD | 3.30 | 3.50 | 3.70 |
| L | 0.45 | 0.65 | 0.85 |




| Dimensions in mm | A | b | c | c1 | D | E | HD | L |
|---|---|---|---|---|---|---|---|---|
| Measurement done on 30 units | | | | | | | | |
| Min | 0.944 | 0.902 | 0.135 | 0.022 | 2.603 | 1.573 | 3.445 | 0.632 |
| Avg. | 0.964 | 0.914 | 0.149 | 0.033 | 2.619 | 1.593 | 3.501 | 0.667 |
| Max | 0.989 | 0.929 | 0.167 | 0.044 | 2.648 | 1.672 | 3.586 | 0.707 |
| LSL | 0.860 | 0.800 | 0.080 | 0.000 | 2.500 | 1.500 | 3.300 | 0.450 |
| Typ. | 0.980 | 0.900 | 0.150 | | 2.600 | 1.600 | 3.500 | 0.650 |
| USL | 1.100 | 1.000 | 0.250 | 0.100 | 2.700 | 1.800 | 3.700 | 0.850 |

## 6.3 Tests description

| Test name | Description | Purpose |
|---|---|---|
| **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.<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. |
| **HTRB** High Temperature Reverse | The diode is biased in static reverse mode at 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.<br>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. |
| **H3TRB** Temperature Humidity 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. |
| **UHAST** Unbiased Highly Accelerated Stress Test | 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. |
| **IOLT** Intermittent Operating Life Test | All test samples shall be subjected to the specified number of cycles. When stabilized after initial warm-up cycles, a cycle shall consist of an "on" period, when power is applied suddenly to the device for the time necessary to achieve a delta case temperature (delta is the high minus the low mounting surface temperatures) of +85°C (+60°C for thyristors) +15°C, -5°C, followed by an off period, when the power is suddenly removed, for cooling the case through a similar delta temperature. | The purpose of this test is to determine compliance with the specified numbers of cycles for devices subjected to the specified conditions. It accelerates the stresses on all bonds and interfaces between the chip and mounting face of devices subjected to repeated turn on and off of equipment and is therefore most appropriate for case mount style (e.g., stud, flange, and disc) devices. |
| **RSH** Resistance to Solder Heat | Package is dipped by the leads in a solder bath after initial wet ageing (for SMDs only). Assessment by electrical test + no external crack | To simulate wave soldering process and verify that package will not be thermally damaged during this step. |
| **DPA** Destructive Physical Analysis | Specific construction analysis on random parts that have successfully completed H3TRB or TC. | To investigate on reliability stresses impact on delamination, corrosion and product construction integrity. |
| **SD** Solderability | The purpose of this test method is to provide a referee condition for the evaluation of the solderability of terminations (including leads up to 0.125 inch in diameter) that will be assembled using tin lead eutectic solder. | This evaluation is made on the basis of the ability of these terminations to be wetted and to produce a suitable fillet when coated by tin lead eutectic solder. These procedures will test whether the packaging materials and processes used during the manufacturing operations process produce a component that can be successfully soldered to the next level assembly using tin lead eutectic solder. A preconditioning test is included in this test method, which degrades the termination finish to provide a guard band against marginal finish. |
| **WG** Whiskers Growth | Forced growing of Tin Whiskers by various kind of environmental stress: temperature, moisture and temperature cycling. | To ensure no risk of electrical short due to Tin Whisker growth. |

# Qualification Report

*Molding compound replacement for SOD123Flat & SOD128Flat packages in Malaysia subcontractor for Rectifiers and Protection diodes*

| General Information | |
|---|---|
| **Product Line** | *Rectifiers* |
| **Product Description** | *Ultrafast, Power Schottky & Power Schottky Trench Diodes* |
| **Product perimeter** | *STPSxxxxZF / STTHxxxxZF*<br>*STPSTxxxxZF*<br>*STPSxxxxAF / STPSTxxxxAF*<br>*STTHxxxxAF* |
| **Product Group** | *ADG* |
| **Product division** | *Discrete & Filter* |
| **Package** | *SOD123-FLAT, SOD128-FLAT* |
| **Maturity level step** | *30* |

| Locations | |
|---|---|
| **Wafer fab** | *Tours 6 – France*<br>*Ang Mo Kio - Singapore* |
| **Assembly plant** | *Subcontractor 996I – Malaysia* |
| **Reliability Lab** | *ST TOURS - FRANCE* |
| **Reliability assessment** | *PASS* |

## DOCUMENT INFORMATION

| Version | Date | Pages | Prepared by | Approved by | Comments |
|---|---|---|---|---|---|
| 1.0 | 23-Nov-2023 | 20 | Yann TURIN | Christophe Goin<br>Digitally signed by Christophe Goin<br>Date: 2023.11.23 15:00:44 +01'00' | 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 |
| **AEC-Q005** | Pb-Free Test Requirements |

# 2 GLOSSARY

| | |
|---|---|
| **SS** | Sample Size |
| **PC** | Pre-Conditioning |
| **HTRB** | High Temperature Reverse Bias |
| **TC** | Temperature Cycling |
| **H3TRB** | High Humidity High Temperature Reverse Bias |
| **IOLT** | Intermittent Operating Life Test |
| **UHAST** | Unbiased Highly Accelerated Stress Test |
| **GD** | Generic Data |
| **SD** | Solderability test |
| **MSL** | Moisture Sensitivity Level |
| **WG** | Whiskers Growth |
| **Tj** | Junction Temperature |
| **BS** | Bond Shear |
| **WBS** | Wire Bond Strength |
| **RSH** | Resistance to Soldering Heat |

# 3 RELIABILITY EVALUATION OVERVIEW

## 3.1 Objectives

The objective of this report is to qualify new molding compound source for SOD123-FLAT and SOD128-FLAT packages.

The involved products are listed in the table here below:

| Product | Description | Package | Assembly Location |
|---|---|---|---|
| STPS1L40ZF<br>STPS1L60ZF<br>STPS2H100ZF | Power Schottky | SOD123-FLAT | Subcontractor 996I – Malaysia |
| STPS360AF<br>STPS3H100AF<br>STPS5H100AF | | SOD128-FLAT | |
| STPST1H100ZF<br>STPST2H100ZF | Power Schottky Trench | SOD123-FLAT | |
| STPST2H100AF<br>STPST1H100AF<br>STPST3H100AF<br>STPST5H100AF | | SOD128-FLAT | |
| STTH1R02ZF<br>STTH1R02ZF | Ultrafast | SOD123-FLAT | |
| STTH1R06AF | | SOD128-FLAT | |

The reliability test methodology used follows the ST 0061692 specification.

The following reliability tests ensuing are:

- TC and IOLT (only for rectifiers) 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, UHAST to check the robustness to corrosion and the good package hermeticity.
- RSH, Solderability to check compatibility of package with customer assembly.
- WG to check lead-finishing quality.

For some tests, similarity methodology is used. See 5.2 “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

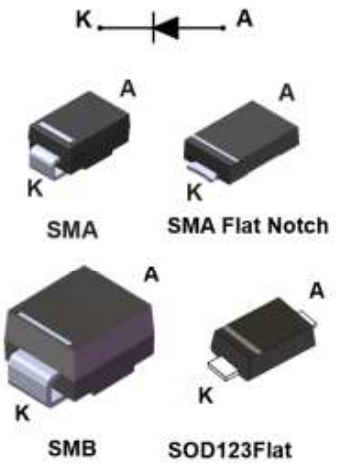
Refer to ST specification (some examples below):

life.augmented

**STPS1L40**

Datasheet

40 V, 1 A low drop power Schottky rectifier




### Features

- Very small conduction losses
- Negligible switching losses
- Low forward voltage drop
- Surface mount miniature packages
- Avalanche rated
- ECOPACK2 compliant

### Applications

- Reverse polarity protection
- Set-top box power supply
- TV power supply
- Battery charger

### Description

Single chip Schottky rectifiers suited to switched mode power supplies and high frequency DC to DC converters.

Packaged in SMA, SMA Flat Notch, SMB and SOD123Flat, the STPS1L40 is ideal for use in surface mounting and used in low voltage, high frequency inverters, free-wheeling and polarity protection applications.

| Product status |
|---|
| STPS1L40 |

| Product summary | |
|---|---|
| **Symbol** | **Value** |
| $I_{F(AV)}$ | 1 A |
| $V_{RRM}$ | 40 V |
| $T_{j(max.)}$ | 175 °C |
| $V_{F(typ.)}$ | 0.37 V |

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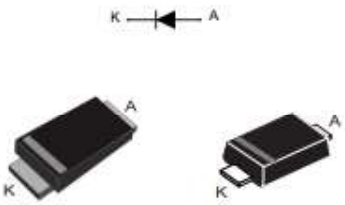
# STPST1H100

Datasheet

## 100 V - 1 A power Schottky trench rectifier




SOD128Flat SOD123Flat

STPOWER

**Product label**

SUSTAINABLE TECHNOLOGY

**Product status link**

STPST1H100

**Product summary**

| | |
|---|---|
| $I_{F(AV)}$ | 1 A |
| $V_{RRM}$ | 100 V |
| $T_j$ (max.) | 175 °C |
| $V_F$ (typ.) | 0.580 V |

## Features

- High junction temperature capability
- Low forward voltage drop
- Low recovery charges
- Reduces conduction, reverse and switching losses
- Avalanche tested
- Flat packages
- ECOPACK2 compliant

## Applications

- DC/DC converter
- LED lighting
- Flyback topology
- Auxiliary power supply
- Switch mode power supply (SMPS)

## Description

This 1 A, 100 V rectifier is based on ST trench technology that achieves the best-in-class $V_F/I_R$ trade-off for a given silicon surface.

Integrated in flat and space-saving packages, this STPST1H100 trench rectifier is intended to be used in high frequency miniature switched mode power supplies. It is also an ideal candidate for auxiliary power supply in telecom, server, or smart metering. ST trench rectifiers are adapted to freewheeling, OR-ring or reverse polarity protection applications, and can be the perfect companion device to our transistors, drivers, or ST VIPer products.

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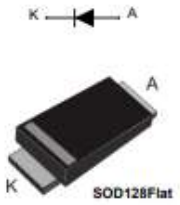
# STTH1R06AF

Datasheet

## 600 V, 1 A, turbo 2 ultrafast rectifier




## Features

- Ultrafast recovery
- Low power losses
- High surge capability
- Low leakage current
- High junction temperature
- ECOPACK2 compliant component

## Applications

- Clamping function
- Boost diode
- PFC

| Product status |
|---|
| STTH1R06AF |

| Product summary | |
|---|---|
| $I_{F(AV)}$ | 1 A |
| $V_{RRM}$ | 600 V |
| $t_{rr}$ | 30 ns |
| $T_j$ | 175 °C |
| $V_{F(typ.)}$ | 1.08 V |

## Description

The STTH1R06AF is an ultrafast recovery power rectifier housed in SOD128Flat to improve space saving.

It is especially designed for clamping function in energy recovery block or boost diode in power correction circuitry.

The compromise between forward voltage drop and recovery time offers optimized performance.

## 4.2 Construction Note

| | *STPSxxxxZF - STPSxxxxAF* |
|---|---|
| **Wafer/Die fab. information** | |
| Wafer fab manufacturing location | Ang Mo Kio - Singapore |
| Technology / Process family | Power Schottky |
| **Wafer Testing (EWS) information** | |
| Electrical testing manufacturing location | Ang Mo Kio - Singapore |
| **Assembly information** | |
| Assembly site | Subcontractor – Malaysia (996I) |
| Package description | SOD123-Flat, SOD128-Flat |
| Molding compound | ECOPACK®2 |
| Lead finishing | Lead free (Pure Tin) |
| **Final testing information** | |
| Testing location | Subcontractor – Malaysia (996I) |

| | *STTHxxxxZF - STTHxxxxAF* |
|---|---|
| **Wafer/Die fab. information** | |
| Wafer fab manufacturing location | Tours - France |
| Technology / Process family | Rectifiers |
| **Wafer Testing (EWS) information** | |
| Electrical testing manufacturing location | Tours - France |
| **Assembly information** | |
| Assembly site | Subcontractor – Malaysia (996I) |
| Package description | SOD123-Flat, SOD128-Flat |
| Molding compound | ECOPACK®2 |
| Lead finishing | Lead free (Pure Tin) |
| **Final testing information** | |
| Testing location | Subcontractor – Malaysia (996I) |

| | *STPSTxxxxZF - STPSTxxxxAF* |
|---|---|
| **Wafer/Die fab. information** | |
| Wafer fab manufacturing location | Ang Mo Kio - Singapore |
| Technology / Process family | Power Schottky Trench |
| **Wafer Testing (EWS) information** | |
| Electrical testing manufacturing location | Ang Mo Kio - Singapore |
| **Assembly information** | |
| Assembly site | Subcontractor – China (998G) |
| Package description | SOD123-Flat, SOD128-Flat |
| Molding compound | ECOPACK®2 |
| Lead finishing | Lead free (Pure Tin) |
| **Final testing information** | |
| Testing location | Subcontractor – China (998G) |

# 5 TESTS RESULTS SUMMARY

## 5.1 Test vehicles

| Lot # | Part Number | Package | Comments |
|---|---|---|---|
| L11 | STPST2H100ZF | SOD 123 | Qualification lot |
| L13 | STTH1R06AFY | SOD 128 | Qualification lot |
| L19 | STTH1R02ZFY | SOD 123 | Qualification lot |
| L15 | STPS2H100ZF | SOD 123 | Qualification lot |
| L17 | STPS5H100AFY | SOD 128 | Qualification lot |
| GD1 | Dummies | SOD 128 | Generic data for whiskers test |

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 | JESD22A-113 | All qualification parts tested per the requirements of the appropriate device specification | | As per targeted MSL<br>Not applicable for PTH and WLCSP without coating | X |
| MSL research | MSL | J-STD-020 | L19, L17 | 60 | Not applicable for PTH and WLCSP without coating | X |
| 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 | All qualification parts tested per the requirements of the appropriate device specification | | | X |
| High Temperature Storage Life | HTSL | JESD22B-101 | | | Covered by HTRB | |
| Temperature Humidity Storage | THS | JESD22 A-118 | | | Covered by H3TRB | |
| High Temperature Gate Bias | HTGB | JESD22A-108 | | | Required for PowerMOSFET – IGBT only. | |
| High Temperature Reverse Bias | HTRB | JESD22A-108 | L13, L11, L15 | 231 | | X |
| High Temperature Forward Bias | HTFB | JESD22A-108 | | | Not required, applicable only to LEDS | |
| High Temperature Operating Life Test | HTOL | JESD22A-108 | | | Covered by HTRB. | |
| Steady State Operational | SSOP | MIL-STD-750-1 M1038 Test B | | | Required for Voltage Regulator (Zener) only. | |
| AC blocking voltage | ACBV | MIL-STD-750-1 M1040 Test A | | | Required for Thyristor only. | |
| Temperature Cycling | TC | JESD22A-104 | L13, L17, L15 | 231 | | 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. | |
| Wire Bond Integrity | WBI | MIL-STD-750 Method 2037 | | | For dissimilar metal bonding systems only | |
| Unbiased Highly Accelerated Stress Test | UHAST | JESD22A-118 | L19, L17, L15 | 231 | | X |
| Autoclave | AC | JESD22A-102 | | | Not recommended | |
| Highly Accelerated Stress Test | HAST | JESD22A-110 | | | Covered by H3TRB | |
| High Humidity High Temperature Reverse Bias | H3TRB | JESD22A-101 | L11, L19, L17, L15 | 308 | | X |
| High Temperature High Humidity Bias | HTHHB | JED22A-101 | | | Not required, LED only | |
| Intermittent Operational Life / Thermal Fatigue | IOL / TF | MIL-STD-750 Method 1037 | L13, L17, L15 | 231 | For power devices. Not required for Transient Voltage Suppressor (TVS) parts | X |
| Power and Temperature Cycle | PTC | JED22A-105 | | | Covered by IOL | |
| ESD Characterization | ESD HBM | AEC Q101-001 and 005 | | | For automotive products only | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Destructive Physical Analysis | DPA | AEC-Q101-004 Section 4 | | | After H3TRB and TC. For automotive products only | |
| Physical Dimension | PD | JESD22B-100 | GD | 60 | See Annexe 6.2 | X |
| 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) | L17, L15 | 60 | Not applicable for SMD pitch < 0.5mm, package size > 5.5*12.5mm and die paddle > 2.5*3.5mm | X |
| Solderability | SD | J-STD-002 JESD22B102 | L13, L15 | 120 | | X |
| Thermal Resistance | TR | JESD24-3, 24-4, 24-6 as appropriate | L13, L11 | 20 | Required in case of process change. See Annex 6.1 - RTH column | X |
| Wire Bond Strength | WBS | MIL-STD-750 Method 2037 | | | NA for products with clip | |
| Bond Shear | BS | AEC-Q101-003 | | | NA for products with clip | |
| 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 | GD1 | 45 | | X |
| Early Life Failure Rate | ELFR | JESD74 | | | Recommended for new techno development in case of identified failure mechanism | |
| Low Temperature Storage | LTS | JESD-22 A119: 209 | | | AQG324 test for Modules | |
| Thermal shock test | TST | JESD22-A104 | | | AQG324 test for Modules | |
| Power Cycling (seconds) | PCsec | MIL-STD750-1 Method1037 | | | AQG324 test for Modules | |
| Power Cycling (minutes) | PCmin | MIL-STD750-1 Method1037 | | | AQG324 test for Modules | |
| Mechanical shock | MS | IEC 600068-2-27 | | | AQG324 test for Modules | |
| Vibration | V | IEC60068-2-6 | | | AQG324 test for Modules | |
| Repetitive Surge | RS | Internal Specification | | | Only for TVS products | |

## 5.3 Results summary

| Test | PC | Std ref. | Conditions | Total | Steps | Results/Lot Fail/S.S. | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Lot 11 | Lot 19 | Lot 15 | Lot 13 | Lot 17 |
| Parametric Verifications | | ST datasheet | Over part temperature range | | - | Refer to paragraph 6.1 in Annexes | | | | |
| External Visual Inspection | | JESD22 B-101 | - | | - | All qualification parts submitted for testing passed External & Visual inspection during manufacturing process | | | | |
| Pre and Post Electrical Test | | ST datasheet | $I_R$, $V_F$ parameters following product datasheet | 1352 | - | 0/1352 | | | | |
| PC | | JESD22A-113 | Drying 24hrs; 125°C Storage 168hrs; 85°C;85%RH IR reflow 3 times | 1412 | - | 0/1121 | | | | |
| MSL1 research | Y | J-STD-020 | MSL=1, Reflow=3 Temperature=85°C Humidity (HR)=85% | 60 | - | | 0/30 | | | 0/30 |
| HTRB | N | JESD22-A108/MIL-STD-750-1 M1038 Method A | Junction Temperature=130°C Temperature=115°C Voltage=80V | 231 | 1000h | 0/77 | | 0/77 | | |
| | | | Junction Temperature=175°C Temperature=170°C Voltage=600V | | 1000h | | | | 0/77 | |
| | | | Junction Temperature=175°C Temperature=170°C Voltage=36V | | 1000h | | | | | |
| TC | Y | JESD22-A104 | Frequency (cy/h)=2cy/h Temperature (high)=150°C Temperature (low)=-55°C | 231 | 500cy | | | 0/77 | 0/77 | 0/77 |
| RSH | Y | JESD22A-111 (SMD) / JESD22B-106 (PTH) | Temperature=260°C Time (on)=10s | 60 | - | | | 0/30 | | 0/30 |
| H3TRB | Y | JESD22-A101 | Humidity (HR)=85% Temperature=85°C Voltage=80V | 308 | 500h | 0/77 | | 0/77 | | 0/77 |
| | | | Humidity (HR)=85% Temperature=85°C Voltage=100V | | 500h | | 0/77 | | | |
| | | | Humidity (HR)=85% Temperature=85°C Voltage=36V | | 500h | | | | | |
| uHAST | Y | JESD22 A-118 | Humidity (HR)=85% Pressure=2.3bar Temperature=130°C | 231 | 96h | | 0/77 | 0/77 | | 0/77 |
| IOLT | Y | MIL-STD 750 Method 1037 | Delta Tj=125°C Intensity (If)=0.8A Time (off)=120s Time (on)=120s | 231 | 500h | | | | 0/77 | |
| | | | Delta Tj=125°C Intensity (If)=1.45A Time (off)=120s Time (on)=120s | | 500h | | | 0/77 | | |
| | | | Delta Tj=125°C Intensity (If)=2.1A Time (off)=120s Time (on)=120s | | 500h | | | | | 0/77 |

| Test | PC | Std ref. | Conditions | Total | Steps | Results/Lot Fail/S.S. | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Lot 11 | Lot 19 | Lot 15 | Lot 13 | Lot 17 |
| SD | N | J-STD-002 | Dry Aging=16Hrs<br>Metal (solder)=SnPb<br>No Data Dream=1<br>No Elec Measurement=1<br>Temperature=220°C | 120 | Visual Inspection | | | 0/15 | 0/15 | |
| | | | Metal (solder)=SnPb<br>No Data Dream=1<br>No Elec Measurement=1<br>Temperature=220°C<br>Wet Aging=8Hrs | | Visual Inspection | | | 0/15 | 0/15 | |
| | | | Dry Aging=16Hrs<br>Metal (solder)=SnAgCu<br>No Data Dream=1<br>No Elec Measurement=1<br>Temperature=245°C | | Visual Inspection | | | 0/15 | 0/15 | |
| | | | Metal (solder)=SnAgCu<br>No Data Dream=1<br>No Elec Measurement=1<br>Temperature=245°C<br>Wet Aging=8Hrs | | Visual Inspection | | | 0/15 | 0/15 | |

| Test | PC | Std ref. | Conditions | Total | Steps | Results/Lot Fail/S.S. |
|---|---|---|---|---|---|---|
| | | | | | | GD 1 |
| Whiskers | N | JESD201 | No reflow<br>THS 30°C/60%RH | 45 | 4000h | 0/9 |
| | | | Reflow SnPb 215°C<br>THS 55°C/85%RH | | 4000h | 0/9 |
| | | | Reflow SnPb 215°C<br>TC -40°C – 85°C | | 1500cy | 0/9 |
| | | | Reflow SnPb 260°C<br>THS 55°C/85%RH | | 4000h | 0/9 |
| | | | Reflow SnPb 260°C<br>TC -40°C – 85°C | | 1500cy | 0/9 |

# 6 ANNEXES

## 6.1 Parametric Verifications

- Results on STTH1R06AFY product:

| TEST | VR | VR | VR | IR | IR |
|---|---|---|---|---|---|
| EQUIPMENT | TESEC_AMK | | | | |
| Condition 1 | -40°C | 25°C | 150°C | 25°C | 150°C |
| Condition 2 | | | | VR=600V | VR=600V |
| Min. Datasheet | *600V* | *600V* | *600V* | | |
| Typ. Datasheet | | | | | *10uA* |
| Max. Datasheet | | | | *1uA* | *75uA* |
| Comments | | | | | |
| UNIT | V | V | V | nA | uA |
| N | 20 | 20 | 20 | 20 | 20 |
| Min | 646.000 | 677.100 | 738.500 | 0.000 | 2.514 |
| Max | 688.300 | 732.500 | 798.500 | 31.300 | 3.290 |
| Avg. | 672.345 | 714.925 | 779.625 | 3.506 | 2.873 |

| TEST | VF | VF | RTH(J-L) |
|---|---|---|---|
| EQUIPMENT | TESEC_AMK | | AMK_RTH_Phase12 |
| Condition 1 | 25°C | 150°C | |
| Condition 2 | IF=1A | IF=1A | |
| Min. Datasheet | | | |
| Typ. Datasheet | | *1.08V* | |
| Max. Datasheet | *1.9V* | *1.4V* | *24°C/W* |
| Comments | | | |
| UNIT | V | V | °C/W |
| N | 20 | 20 | 10 |
| Min | 1.374 | 1.028 | 14.900 |
| Max | 1.544 | 1.121 | 16.190 |
| Avg. | 1.477 | 1.086 | 15.651 |

- Results on STPS2H100ZF product:

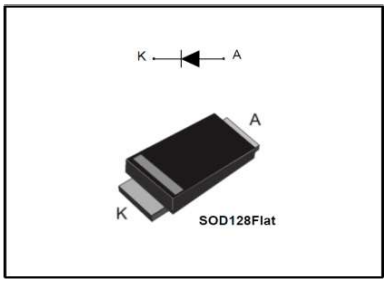
| TEST | VF | VF | VF | VF | IR | IR |
|---|---|---|---|---|---|---|
| EQUIPMENT | TESEC_AMK | | | | | |
| Condition 1 | 24°C | 24°C | 125°C | 125°C | 24°C | 125°C |
| Condition 2 | IF=2A | IF=4A | IF=2A | IF=4A | VR=100V | VR=100V |
| Min. Datasheet | | | | | | |
| Typ. Datasheet | | | *0.65V* | *0.75V* | | *0.2mA* |
| Max. Datasheet | *0.86V* | *0.96V* | *0.7V* | *0.83V* | *1uA* | *0.5mA* |
| Comments | | | | | | |
| UNIT | V | V | V | V | nA | uA |
| N | 20 | 20 | 20 | 20 | 20 | 20 |
| Min | 0.786 | 0.853 | 0.635 | 0.707 | 78.020 | 123.700 |
| Max | 0.791 | 0.861 | 0.642 | 0.716 | 126.600 | 170.300 |
| Avg. | 0.789 | 0.857 | 0.640 | 0.713 | 90.865 | 136.840 |

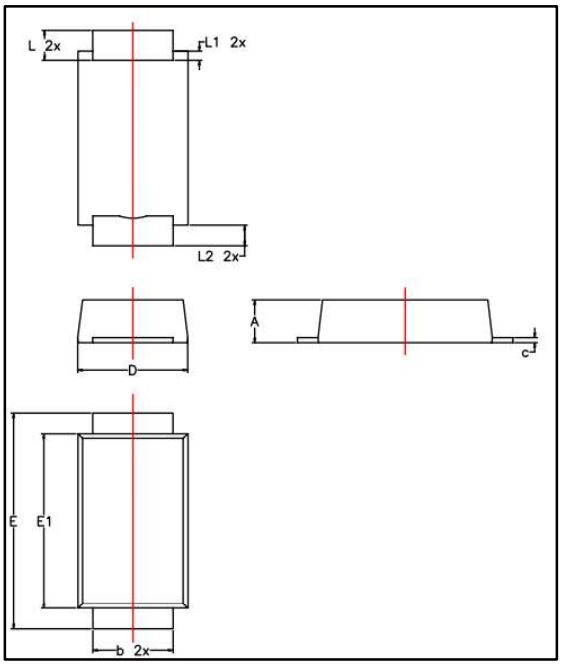
| TEST | VR | VR | VR | RTH(J-L) |
|---|---|---|---|---|
| EQUIPMENT | TESEC_AMK | | | AMK_RTH_Phase12 |
| Condition 1 | -40°C | 24°C | 125°C | |
| Condition 2 | | | | |
| Min. Datasheet | *100V* | *100V* | *100V* | |
| Typ. Datasheet | | | | |
| Max. Datasheet | | | | *20°C/W* |
| Comments | | | | |
| UNIT | V | V | V | °C/W |
| N | 20 | 20 | 20 | 10 |
| Min | 118.500 | 125.700 | 137.700 | 13.180 |
| Max | 120.300 | 127.300 | 139.500 | 15.680 |
| Avg. | 119.365 | 126.435 | 138.650 | 14.176 |

## 6.2 Physical Dimensions

# Dimensional report for SOD128 Flat package

| Ref. | Dimensions | |
|---|---|---|
| | Millimeters | |
| | Min. | Max. |
| A | 0.93 | 1.03 |
| b | 1.69 | 1.81 |
| c | 0.10 | 0.22 |
| D | 2.30 | 2.50 |
| E | 4.60 | 4.80 |
| E1 | 3.70 | 3.90 |
| L | 0.55 | 0.85 |
| L1 | 0.30 typ. | |
| L2 | 0.45 typ. | |

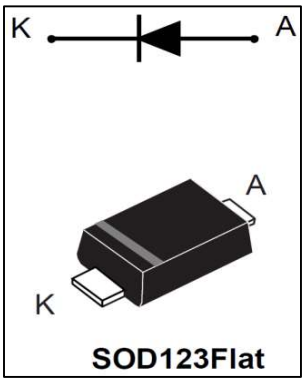


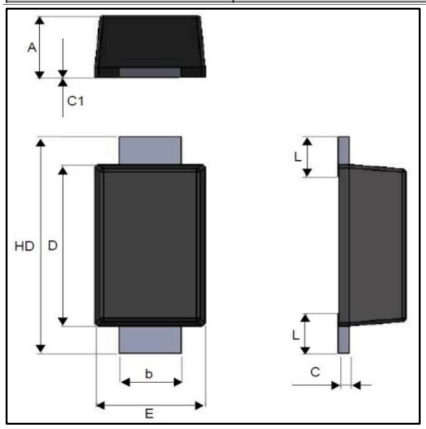




| Dimensions in mm | A | b | c | D | E | E1 | L | L1 | L2 |
|---|---|---|---|---|---|---|---|---|---|
| Measurement done on 30 units | | | | | | | | | |
| Min | 0.937 | 1.691 | 0.150 | 2.313 | 4.666 | 3.782 | 0.711 | 0.248 | 0.426 |
| Avg. | 0.955 | 1.712 | 0.160 | 2.401 | 4.685 | 3.817 | 0.743 | 0.277 | 0.466 |
| Max | 0.979 | 1.737 | 0.171 | 2.421 | 4.697 | 3.830 | 0.793 | 0.314 | 0.506 |
| LSL | 0.930 | 1.690 | 0.100 | 2.300 | 4.600 | 3.700 | 0.550 | | |
| Typ. | | | | | | | | 0.300 | 0.450 |
| USL | 1.030 | 1.810 | 0.220 | 2.500 | 4.800 | 3.900 | 0.850 | | |

# Dimensional report for SOD123 Flat package

| Ref. | Dimensions | | |
|---|---|---|---|
| | Millimeters | | |
| | Min. | Typ. | Max. |
| A | 0.86 | 0.98 | 1.10 |
| b | 0.80 | 0.90 | 1.00 |
| c | 0.08 | 0.15 | 0.25 |
| c1 | 0.00 | | 0.10 |
| D | 2.50 | 2.60 | 2.70 |
| E | 1.50 | 1.60 | 1.80 |
| HD | 3.30 | 3.50 | 3.70 |
| L | 0.45 | 0.65 | 0.85 |




| Dimensions in mm | A | b | c | c1 | D | E | HD | L |
|---|---|---|---|---|---|---|---|---|
| Measurement done on 30 units | | | | | | | | |
| Min | 0.944 | 0.902 | 0.135 | 0.022 | 2.603 | 1.573 | 3.445 | 0.632 |
| Avg. | 0.964 | 0.914 | 0.149 | 0.033 | 2.619 | 1.593 | 3.501 | 0.667 |
| Max | 0.989 | 0.929 | 0.167 | 0.044 | 2.648 | 1.672 | 3.586 | 0.707 |
| LSL | 0.860 | 0.800 | 0.080 | 0.000 | 2.500 | 1.500 | 3.300 | 0.450 |
| Typ. | 0.980 | 0.900 | 0.150 | | 2.600 | 1.600 | 3.500 | 0.650 |
| USL | 1.100 | 1.000 | 0.250 | 0.100 | 2.700 | 1.800 | 3.700 | 0.850 |

## 6.3 Tests description

| Test name | Description | Purpose |
|---|---|---|
| **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.<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. |
| **HTRB** High Temperature Reverse | The diode is biased in static reverse mode at 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.<br>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. |
| **H3TRB** Temperature Humidity 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. |
| **UHAST** Unbiased Highly Accelerated Stress Test | 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. |
| **IOLT** Intermittent Operating Life Test | All test samples shall be subjected to the specified number of cycles. When stabilized after initial warm-up cycles, a cycle shall consist of an "on" period, when power is applied suddenly to the device for the time necessary to achieve a delta case temperature (delta is the high minus the low mounting surface temperatures) of +85°C (+60°C for thyristors) +15°C, -5°C, followed by an off period, when the power is suddenly removed, for cooling the case through a similar delta temperature. | The purpose of this test is to determine compliance with the specified numbers of cycles for devices subjected to the specified conditions. It accelerates the stresses on all bonds and interfaces between the chip and mounting face of devices subjected to repeated turn on and off of equipment and is therefore most appropriate for case mount style (e.g., stud, flange, and disc) devices. |
| **RSH** Resistance to Solder Heat | Package is dipped by the leads in a solder bath after initial wet ageing (for SMDs only). Assessment by electrical test + no external crack | To simulate wave soldering process and verify that package will not be thermally damaged during this step. |
| **SD** Solderability | The purpose of this test method is to provide a referee condition for the evaluation of the solderability of terminations (including leads up to 0.125 inch in diameter) that will be assembled using tin lead eutectic solder. | This evaluation is made on the basis of the ability of these terminations to be wetted and to produce a suitable fillet when coated by tin lead eutectic solder. These procedures will test whether the packaging materials and processes used during the manufacturing operations process produce a component that can be successfully soldered to the next level assembly using tin lead eutectic solder. A preconditioning test is included in this test method, which degrades the termination finish to provide a guard band against marginal finish. |
| **WG** Whiskers Growth | Forced growing of Tin Whiskers by various kind of environmental stress: temperature, moisture and temperature cycling. | To ensure no risk of electrical short due to Tin Whisker growth. |

# *PCN*
# *Product/Process Change Notification*

## Molding compound replacement for SOD123Flat & SOD128Flat

## in subcontractor in Malaysia for Rectifiers and Protection diodes

| | | | |
|---|---|---|---|
| **Notification number:** | ADG/23/14357 | **Issue Date** | 30-Nov-2023 |
| **Issued by** | Sophie da Silva | | |

| | |
|---|---|
| **Product series affected by the change** | STPSxxxxZF / STPSxxxxZFY<br>STTHxxxxZF / STTHxxxxZFY<br>STPSTxxxxZF / STPSTxxxxZFY<br><br>STPSxxxxAF / STPSxxxxAFY<br>STPSTxxxxAF / STPSTxxxxAFY<br>STTHxxxxAF / STTHxxxxAFY<br>SMxFxxAY<br><br>Refer to attached table for involved Commercial Products. |
| **Type of change** | Back-End realization |

**Description of the change**

Molding compound replacement for SOD123Flat & SOD128Flat packages for Rectifiers and Protection diodes manufactured in subcontractor in Malaysia.

This new molding compound is produced by the same supplier, the same reference but different manufacturing plant.

**Reason for change**

Molding compound discontinuation from current resin supplier, produced in Singapore.

| | |
|---|---|
| **Former versus changed product:** | The changed products do not present modified electrical, dimensional, or thermal parameters, leaving unchanged the current information published in the products datasheets.<br><br>The footprint recommended by ST remains the same.<br><br>There is no change in the packing modes and the standard delivery quantities either.<br><br>The products remain in full compliance with the ST ECOPACK®2 grade (so called “halogen-free”). |

**Disposition of former products**

Delivery of current products will be done until stock depletion.

**Marking and traceability**

Traceability of the change will be ensured by Finished Good/Type print on carton labels.
New Finished Good ending with "J" as per below:

| Commercial part number/Order code (Examples) | Former Finished Good/Type (Examples) | New Finished Good/Type (Examples) |
|---|---|---|
| STTH1R02ZFY | YSTTH1R02ZF/I | YSTTH1R02ZFJ/I |
| STPS2H100ZFY | YSTPS2H100ZF%I | YSTPS2H100ZFJ%I |
| STPST2H100ZF | PST2H100ZF%I | PST2H100ZFJ%I |
| STTH1R06AFY | YTH1R06AF/I | YTH1R06AFJ/I |
| SM6F36AY | ASM6F36AY-I | ASM6F36AYJ-I |
| STPS5H100AFY | YPS5H100AF%I | YPS5H100AFJ%I |

| | |
|---|---|
| **Qualification completion date** | 28-Nov-2023 |

**Forecasted sample availability**

| Product family | Sub-family | Commercial part Number | Availability date |
|---|---|---|---|
| **Rectifiers** | Power Schottky | STPS1L60ZFY | **Week 01-2024** |
| **Rectifiers** | Power Schottky | STPS2H100ZF | **Week 01-2024** |
| **Rectifiers** | Power Schottky | STPS2H100ZFY | **Week 01-2024** |
| **Rectifiers** | Power Schottky | STPS360AFY | **Week 01-2024** |
| **Rectifiers** | Power Schottky | STPS3H100AFY | **Week 01-2024** |
| **Rectifiers** | Power Schottky | STPS5H100AFY | **Week 01-2024** |
| **Rectifiers** | Ultrafast | STTH1R02ZF | **Week 01-2024** |
| **Rectifiers** | Ultrafast | STTH1R02ZFY | **Week 01-2024** |
| **Rectifiers** | Ultrafast | STTH2R02AFY | **Week 01-2024** |
| **Protection** | TVS | SM6F31AY | **Week 01-2024** |

For sample(s) request, please inform FSE (Field Sales Engineer) in order to insert corresponding **Non-Standard Samples Order** (a single Commercial Product for each request) with **PCN reference** as additional information.

Other samples are available upon request.

**Change implementation schedule**

| Sales-types | Estimated production start | Estimated first shipments |
|---|---|---|
| **All** | **Jun-2024** | **Jul-2024** |

| | |
|---|---|
| **Comments** | With early PCN acceptance, possible shipment starting Apr-2024. |
| **Customer's feedback**<br><br>Please contact your local ST sales representative or quality contact for requests concerning this change notification.<br>Absence of acknowledgement of this PCN within 30 days of receipt will constitute acceptance of the change<br>Absence of additional response within 180 days of receipt of this PCN will constitute acceptance of the change | |
| **Qualification program and results** | 23033QRP Attached<br>23034QRP Attached |

| Involved Commercial part numbers | |
|---|---|
| SM6F10AY | STPS2L40ZFY |
| SM6F11AY | STPS2L60ZFY |
| SM6F12AY | STPS360AF |
| SM6F13AY | STPS360AFY |
| SM6F14AY | STPS3H100AF |
| SM6F15AY | STPS3H100AFY |
| SM6F16AY | STPS5H100AF |
| SM6F18AY | STPS5H100AFY |
| SM6F20AY | STPST1H100AF |
| SM6F22AY | STPST1H100AFY |
| SM6F23AY | STPST1H100ZF |
| SM6F24AY | STPST1H100ZFY |
| SM6F26AY | STPST2H100AF |
| SM6F28AY | STPST2H100AFY |
| SM6F30AY | STPST2H100ZF |
| SM6F31AY | STPST2H100ZFY |
| SM6F33AY | STPST3H100AF |
| SM6F36AY | STPST3H100AFY |
| SM6F5.0AY | STPST5H100AF |
| SM6F6.0AY | STPST5H100AFY |
| SM6F6.5AY | STTH1R02ZF |
| SM6F8.5AY | STTH1R02ZF |
| STPS1L40ZF | STTH1R02ZFY |
| STPS1L40ZFY | STTH1R02ZFY |
| STPS1L60ZF | STTH1R06AF |
| STPS1L60ZFY | STTH1R06AFY |
| STPS2H100AFY | STTH2R02AFY |
| STPS2H100ZF | STTH3R02AFY |
| STPS2H100ZFY | |

# Qualification Report

*Molding compound replacement for SOD123Flat & SOD128Flat packages in Malaysia subcontractor for Rectifiers and Protection diodes – Automotive grade*

| General Information | |
|---|---|
| **Product Line** | *Rectifiers & Protection* |
| **Product Description** | *Ultrafast, Power Schottky & Power Schottky Trench Diodes, TVS* |
| **Product perimeter** | *STPSxxxxZFY / STTHxxxxZFY*<br>*STPSTxxxxZFY*<br>*STPSxxxxAFY / STPSTxxxxAFY*<br>*STTHxxxxAFY / SMxFxxAY* |
| **Product Group** | *ADG* |
| **Product division** | *Discrete & Filter* |
| **Package** | *SOD123-FLAT, SOD128-FLAT* |
| **Maturity level step** | *30* |

| Locations | |
|---|---|
| **Wafer fab** | *Tours 6 – France*<br>*Ang Mo Kio - Singapore* |
| **Assembly plant** | *Subcontractor 996I – Malaysia* |
| **Reliability Lab** | *ST TOURS - FRANCE* |
| **Reliability assessment** | *PASS* |

## DOCUMENT INFORMATION

| Version | Date | Pages | Prepared by | Approved by | Comments |
|---|---|---|---|---|---|
| 1.0 | 23-Nov-2023 | 20 | Yann TURIN | Christophe Goin<br>Digitally signed by Christophe Goin<br>Date: 2023.11.23 14:59:36 +01'00' | 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 |
| **AEC-Q005** | Pb-Free Test Requirements |
| **AEC-Q101 Rev E** | Failure Mechanism Based Stress Test Qualification for Discrete Semiconductors in Automotive Applications |

# 2 GLOSSARY

| | |
|---|---|
| **SS** | Sample Size |
| **PC** | Pre-Conditioning |
| **HTRB** | High Temperature Reverse Bias |
| **TC** | Temperature Cycling |
| **H3TRB** | High Humidity High Temperature Reverse Bias |
| **IOLT** | Intermittent Operating Life Test |
| **UHAST** | Unbiased Highly Accelerated Stress Test |
| **GD** | Generic Data |
| **SD** | Solderability test |
| **MSL** | Moisture Sensitivity Level |
| **WG** | Whiskers Growth |
| **Tj** | Junction Temperature |
| **BS** | Bond Shear |
| **WBS** | Wire Bond Strength |
| **RSH** | Resistance to Soldering Heat |
| **DPA** | Destructive Physical Analysis (after TC and THB) |

# 3 RELIABILITY EVALUATION OVERVIEW

## 3.1 Objectives

The objective of this report is to qualify new molding compound source for SOD123-FLAT and SOD128-FLAT packages.

The involved products are listed in the table here below:

| Product | Description | Package | Assembly Location |
|---|---|---|---|
| SM6F10AY<br>SM6F11AY<br>SM6F12AY<br>SM6F13AY<br>SM6F14AY<br>SM6F15AY<br>SM6F16AY<br>SM6F18AY<br>SM6F20AY<br>SM6F22AY<br>SM6F23AY<br>SM6F24AY<br>SM6F26AY<br>SM6F28AY<br>SM6F30AY<br>SM6F31AY<br>SM6F33AY<br>SM6F36AY<br>SM6F5.0AY<br>SM6F6.0AY<br>SM6F6.5AY<br>SM6F8.5AY | TVS | SOD128-FLAT | Subcontractor 996I – Malaysia |
| STPS1L40ZFY<br>STPS1L60ZFY<br>STPS2H100ZFY<br>STPS2L40ZFY<br>STPS2L60ZFY | Power Schottky | SOD123-FLAT | |
| STPS2H100AFY<br>STPS360AFY<br>STPS3H100AFY<br>STPS5H100AFY | | SOD128-FLAT | |
| STPST1H100ZFY<br>STPST2H100ZFY | Power Schottky Trench | SOD123-FLAT | |
| STPST1H100AFY<br>STPST2H100AFY<br>STPST3H100AFY<br>STPST5H100AFY | | SOD128-FLAT | |
| STTH1R02ZFY<br>STTH1R02ZFY | Ultrafast | SOD123-FLAT | |
| STTH1R06AFY<br>STTH2R02AFY<br>STTH3R02AFY | | SOD128-FLAT | |

The reliability test methodology used follows the ST 0061692 & AEC Q101 Rev. E specifications.

The following reliability tests ensuing are:

- TC and IOLT (only for rectifiers) 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, UHAST to check the robustness to corrosion and the good package hermeticity.
- RSH, Solderability to check compatibility of package with customer assembly.
- WG to check lead-finishing quality.

For some tests, similarity methodology is used. See 5.2 “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

Refer to ST specification (some examples below):

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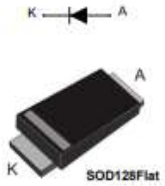
**STPST3H100-Y**

Datasheet

Automotive 100 V - 3 A power Schottky trench diode




### Features

- AEC-Q101 qualified
- PPAP capable
- ST trench process
- High junction temperature capability
- Low forward voltage drop
- Low recovery charges
- Reduces conduction, reverse and switching losses
- Flat package
- ECOPACK2 compliant

### Applications

- DC/DC converter
- Auxiliary power supply
- High switching frequency converter
- Flyback topology
- Reverse polarity protection
- Freewheeling function

### Description

This 3 A, 100 V rectifier is based on ST trench technology that achieves the best in class $V_F/I_R$ trade-off for a given silicon surface.

Integrated in flat packages, this STPST3H100-Y trench device is intended to be used in high frequency miniature switched mode power supplies such as adaptors. It is also an ideal candidate for auxiliary power supply in telecom, server, lighting or smart metering and can be the perfect companion device to our VIPer products.

| Product status link |
|---|
| STPST3H100-Y |

| Product summary | |
|---|---|
| $I_{F(AV)}$ | 3 A |
| $V_{RRM}$ | 100 V |
| $T_j$ (max.) | 175 °C |
| $V_F$ (typ.) | 0.600 V |

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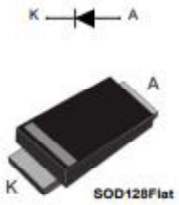
# STTH1R06AFY

Datasheet

## Automotive 600 V, 1 A, turbo 2 ultrafast rectifier




## Features

- AEC-Q101 qualified
- Ultrafast recovery
- $V_{RRM}$ 600 V up to -40 °C
- Low power losses
- High surge capability
- Low leakage current
- High junction temperature
- PPAP capable
- ECOPACK®2 compliant component

## Applications

- Reverse polarity protection
- Clamping function
- Boost diode
- PFC

## Description

The STTH1R06AFY is an ultrafast recovery power rectifier dedicated to energy recovery in automotive application housed in SOD128Flat to improve space saving.

It is especially designed for clamping function in energy recovery block.

The compromise between forward voltage drop and recovery time offers optimized performance.

| Product status |
|---|
| STTH1R06AFY |

| Product summary | |
|---|---|
| $I_{F(AV)}$ | 1 A |
| $V_{RRM}$ | 600 V |
| $t_{rr}$ | 30 ns |
| $T_j$ | 175 °C |
| $V_{F(typ.)}$ | 1.08 V |

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# SM6FxxAY

Datasheet

## Automotive 600 W TVS in SOD128 Flat


**SOD128 Flat**


**Unidirectional**

| Product status link | |
|---|---|
| SM6FY | SM6F5.0AY, SM6F6.0AY, SM6F6.5AY, SM6F8.5AY, SM6F10AY, SM6F11AY, SM6F13AY, SM6F12AY, SM6F14AY, SM6F15AY, SM6F16AY, SM6F18AY, SM6F20AY, SM6F22AY, SM6F23AY, SM6F24AY, SM6F26AY, SM6F28AY, SM6F30AY, SM6F31AY, SM6F33AY, SM6F36AY |

## Features

- AEC-Q101 qualified
- Peak pulse power: 600 W (10/1000 µs) and 4 kW (8/20 µs)
- Stand-off voltage range from 5 V to 36 V
- Unidirectional type
- Low leakage current: 0.2 µA at 25 °C and 1 µA at 85 °C
- Operating $T_j$ max: 175 °C
- High power capability at 175 °C ($T_j$ max.) up to 240 W (10/1000 µs)
- Lead finishing: matte tin platting

## 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
- ISO10605, IEC 61000-4-2, C= 150 pF - R = 330 Ω exceeds level 4:
  - 30 kV (air discharge)
  - 30 kV (contact discharge)
- ISO10605 - C = 330 pF, R = 330 Ω exceeds level 4:
  - 30 kV (air discharge)
  - 30 kV (contact discharge)
- ISO7637-2 (Not applicable to parts with stand-off voltage lower than battery voltage)
  - Pulse1: $V_S$ = -150 V
  - Pulse 2a: $V_S$ = +112 V
  - Pulse 3a: $V_S$ = -220 V
  - Pulse 3b: $V_S$ = +150 V

## Description

The SM6FY series are designed to protect sensitive automotive circuits against surges defined in ISO 7637-2 and against electrostatic discharges according to ISO 10605.

The Planar technology makes it compatible with high-end circuits where low leakage current and high junction temperature are required to provide long term reliability and stability.

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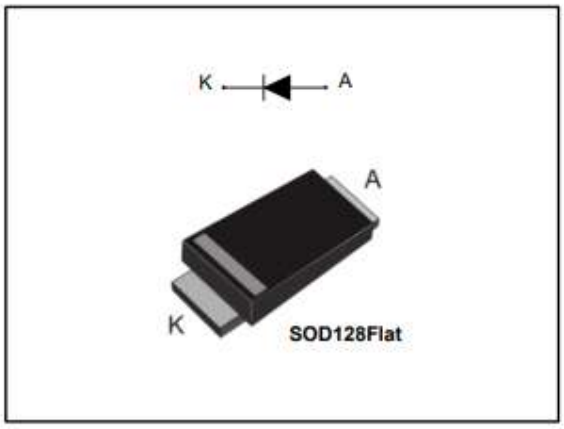
# STPS5H100AFY

## Automotive high voltage power Schottky rectifier

Datasheet - production data




## Description

This high voltage Schottky barrier rectifier device is packaged in SOD128Flat and designed for high frequency miniature switched mode power supplies and for board DC to DC converters for automotive applications.

**Table 1: Device summary**

| Symbol | Value |
|---|---|
| $I_{F(AV)}$ | 5 A |
| $V_{RRM}$ | 100 V |
| $T_j$(max.) | 175 °C |
| $V_F$(typ.) | 0.51 V |

## Features

- Negligible switching losses
- High junction temperature capability
- Low leakage current
- Good trade-off between leakage current and forward voltage drop
- Avalanche specification
- ECOPACK® compliant component
- AEC-Q101
- PPAP capable
- $V_{RRM}$ guaranteed from -40 to +175 °C

## 4.2 Construction Note

| | *STPSxxxxZFY - STPSxxxxAFY* |
|---|---|
| **Wafer/Die fab. information** | |
| Wafer fab manufacturing location | Ang Mo Kio - Singapore |
| Technology / Process family | Power Schottky |
| **Wafer Testing (EWS) information** | |
| Electrical testing manufacturing location | Ang Mo Kio - Singapore |
| **Assembly information** | |
| Assembly site | Subcontractor – Malaysia (996I) |
| Package description | SOD123-Flat, SOD128-Flat |
| Molding compound | ECOPACK®2 |
| Lead finishing | Lead free (Pure Tin) |
| **Final testing information** | |
| Testing location | Subcontractor – Malaysia (996I) |

| | *STTHxxxxZFY - STTHxxxxAFY* |
|---|---|
| **Wafer/Die fab. information** | |
| Wafer fab manufacturing location | Tours - France |
| Technology / Process family | Rectifiers |
| **Wafer Testing (EWS) information** | |
| Electrical testing manufacturing location | Tours - France |
| **Assembly information** | |
| Assembly site | Subcontractor – Malaysia (996I) |
| Package description | SOD123-Flat, SOD128-Flat |
| Molding compound | ECOPACK®2 |
| Lead finishing | Lead free (Pure Tin) |
| **Final testing information** | |
| Testing location | Subcontractor – Malaysia (996I) |

| | *STPSTxxxxZFY - STPSTxxxxAFY* |
|---|---|
| **Wafer/Die fab. information** | |
| Wafer fab manufacturing location | Ang Mo Kio - Singapore |
| Technology / Process family | Power Schottky Trench |
| **Wafer Testing (EWS) information** | |
| Electrical testing manufacturing location | Ang Mo Kio - Singapore |
| **Assembly information** | |
| Assembly site | Subcontractor – China (998G) |
| Package description | SOD123-Flat, SOD128-Flat |
| Molding compound | ECOPACK®2 |
| Lead finishing | Lead free (Pure Tin) |
| **Final testing information** | |
| Testing location | Subcontractor – China (998G) |

| | *SMxFxxAY* |
|---|---|
| **Wafer/Die fab. information** | |
| Wafer fab manufacturing location | Tours - France |
| Technology / Process family | TVS |
| **Wafer Testing (EWS) information** | |
| Electrical testing manufacturing location | Tours - France |
| **Assembly information** | |
| Assembly site | Subcontractor – Malaysia (996I) |
| Package description | SOD128-Flat |
| Molding compound | ECOPACK®2 |
| Lead finishing | Lead free (Pure Tin) |
| **Final testing information** | |
| Testing location | Subcontractor – Malaysia (996I) |

# 5 TESTS RESULTS SUMMARY

## 5.1 Test vehicles

| Lot # | Part Number | Package | Comments |
|---|---|---|---|
| L11 | STPST2H100ZF | SOD 123 | Qualification lot |
| L13 | STTH1R06AFY | SOD 128 | Qualification lot |
| L20 | SM6F36AY | SOD 128 | Qualification lot |
| L19 | STTH1R02ZFY | SOD 123 | Qualification lot |
| L15 | STPS2H100ZF | SOD 123 | Qualification lot |
| L17 | STPS5H100AFY | SOD 128 | Qualification lot |
| GD1 | Dummies | SOD 128 | Generic data for whiskers test |

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 | JESD22A-113 | All qualification parts tested per the requirements of the appropriate device specification | | As per targeted MSL<br>Not applicable for PTH and WLCSP without coating | X |
| MSL research | MSL | J-STD-020 | L20, L19, L17 | 90 | Not applicable for PTH and WLCSP without coating | X |
| 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 | All qualification parts tested per the requirements of the appropriate device specification | | | X |
| High Temperature Storage Life | HTSL | JESD22B-101 | | | Covered by HTRB | |
| Temperature Humidity Storage | THS | JESD22 A-118 | | | Covered by H3TRB | |
| High Temperature Gate Bias | HTGB | JESD22A-108 | | | Required for PowerMOSFET – IGBT only. | |
| High Temperature Reverse Bias | HTRB | JESD22A-108 | L13, L20, L11, L15 | 308 | | X |
| High Temperature Forward Bias | HTFB | JESD22A-108 | | | Not required, applicable only to LEDS | |
| High Temperature Operating Life Test | HTOL | JESD22A-108 | | | Covered by HTRB. | |
| Steady State Operational | SSOP | MIL-STD-750-1 M1038 Test B | | | Required for Voltage Regulator (Zener) only. | |
| AC blocking voltage | ACBV | MIL-STD-750-1 M1040 Test A | | | Required for Thyristor only. | |
| Temperature Cycling | TC | JESD22A-104 | L13, L20, L17, L15 | 308 | | 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. | |
| Wire Bond Integrity | WBI | MIL-STD-750 Method 2037 | | | For dissimilar metal bonding systems only | |
| Unbiased Highly Accelerated Stress Test | UHAST | JESD22A-118 | L20, L19, L17, L15 | 308 | | X |
| Autoclave | AC | JESD22A-102 | | | Not recommended | |
| Highly Accelerated Stress Test | HAST | JESD22A-110 | | | Covered by H3TRB | |
| High Humidity High Temperature Reverse Bias | H3TRB | JESD22A-101 | L11, L20, L19, L17, L15 | 385 | | X |
| High Temperature High Humidity Bias | HTHHB | JED22A-101 | | | Not required, LED only | |
| Intermittent Operational Life / Thermal Fatigue | IOL / TF | MIL-STD-750 Method 1037 | L13, L17, L15 | 231 | For power devices. Not required for Transient Voltage Suppressor (TVS) parts | X |
| Power and Temperature Cycle | PTC | JED22A-105 | | | Covered by IOL | |
| ESD Characterization | ESD HBM | AEC Q101-001 and 005 | | | For automotive products only See Annexe 6.1 | X |

| | | | | | | |
|---|---|---|---|---|---|---|
| Destructive Physical Analysis | DPA | AEC-Q101-004 Section 4 | L13, L19 | 4 | After H3TRB and TC. For automotive products only | X |
| Physical Dimension | PD | JESD22B-100 | GD | 60 | See Annexe 6.2 | X |
| 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) | L20, L17, L15 | 90 | Not applicable for SMD pitch < 0.5mm, package size > 5.5*12.5mm and die paddle > 2.5*3.5mm | X |
| Solderability | SD | J-STD-002 JESD22B102 | L13, L15 | 120 | | X |
| Thermal Resistance | TR | JESD24-3, 24-4, 24-6 as appropriate | L13, L20, L11 | 25 | Required in case of process change. See Annex 6.1 - RTH column | X |
| Wire Bond Strength | WBS | MIL-STD-750 Method 2037 | | | NA for products with clip | |
| Bond Shear | BS | AEC-Q101-003 | | | NA for products with clip | |
| 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 | GD1 | 45 | | X |
| Early Life Failure Rate | ELFR | JESD74 | | | Recommended for new techno development in case of identified failure mechanism | |
| Low Temperature Storage | LTS | JESD-22 A119: 209 | | | AQG324 test for Modules | |
| Thermal shock test | TST | JESD22-A104 | | | AQG324 test for Modules | |
| Power Cycling (seconds) | PCsec | MIL-STD750-1 Method1037 | | | AQG324 test for Modules | |
| Power Cycling (minutes) | PCmin | MIL-STD750-1 Method1037 | | | AQG324 test for Modules | |
| Mechanical shock | MS | IEC 600068-2-27 | | | AQG324 test for Modules | |
| Vibration | V | IEC60068-2-6 | | | AQG324 test for Modules | |
| Repetitive Surge | RS | Internal Specification | | | Only for TVS products | |

## 5.3 Results summary

| Test | PC | Std ref. | Conditions | Total | Steps | Results/Lot Fail/S.S. | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Lot 11 | Lot 19 | Lot 15 | Lot 13 | Lot 20 | Lot 17 |
| Parametric Verifications | | ST datasheet | Over part temperature range | | - | Refer to paragraph 6.1 in Annexes | | | | | |
| External Visual Inspection | | JESD22 B-101 | - | | - | All qualification parts submitted for testing passed External & Visual inspection during manufacturing process | | | | | |
| Pre and Post Electrical Test | | ST datasheet | $I_R$, $V_F$ parameters following product datasheet | 1885 | - | 0/1885 | | | | | |
| PC | | JESD22A-113 | Drying 24hrs; 125°C Storage 168hrs; 85°C;85%RH IR reflow 3 times | 1412 | - | 0/1412 | | | | | |
| MSL1 research | Y | J-STD-020 | MSL=1, Reflow=3 Temperature=85°C Humidity (HR)=85% | 90 | - | | 0/30 | | | 0/30 | 0/30 |
| HTRB | N | JESD22-A108/MIL-STD-750-1 M1038 Method A | Junction Temperature=130°C Temperature=115°C Voltage=80V | 308 | 1000h | 0/77 | | 0/77 | | | |
| | | | Junction Temperature=175°C Temperature=170°C Voltage=600V | | 1000h | | | | 0/77 | | |
| | | | Junction Temperature=175°C Temperature=170°C Voltage=36V | | 1000h | | | | | 0/77 | |
| TC | Y | JESD22-A104 | Frequency (cy/h)=2cy/h Temperature (high)=150°C Temperature (low)=-55°C | 308 | 1000cy | | | 0/77 | 0/77 | 0/77 | 0/77 |
| RSH | Y | JESD22A-111 (SMD) / JESD22B-106 (PTH) | Temperature=260°C Time (on)=10s | 90 | - | | | 0/30 | | 0/30 | 0/30 |
| H3TRB | Y | JESD22-A101 | Humidity (HR)=85% Temperature=85°C Voltage=80V | 385 | 1000h | 0/77 | | 0/77 | | | 0/77 |
| | | | Humidity (HR)=85% Temperature=85°C Voltage=100V | | 1000h | | 0/77 | | | | |
| | | | Humidity (HR)=85% Temperature=85°C Voltage=36V | | 1000h | | | | | 0/77 | |
| uHAST | Y | JESD22 A-118 | Humidity (HR)=85% Pressure=2.3bar Temperature=130°C | 308 | 96h | | 0/77 | 0/77 | | 0/77 | 0/77 |
| IOLT | Y | MIL-STD 750 Method 1037 | Delta Tj=125°C Intensity (If)=0.8A Time (off)=120s Time (on)=120s | 231 | 500h | | | | 0/77 | | |
| | | | Delta Tj=125°C Intensity (If)=1.45A Time (off)=120s Time (on)=120s | | 500h | | | 0/77 | | | |
| | | | Delta Tj=125°C Intensity (If)=2.1A Time (off)=120s Time (on)=120s | | 500h | | | | | | 0/77 |
| DPA | Y | ST 0060102 AEC Q101 | Post TC or H3TRB | 4 | - | | 0/2 | | 0/2 | | |

| Test | PC | Std ref. | Conditions | Total | Steps | Results/Lot Fail/S.S. | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Lot 11 | Lot 19 | Lot 15 | Lot 13 | Lot 20 | Lot 17 |
| SD | N | J-STD-002 | Dry Aging=16Hrs<br>Metal (solder)=SnPb<br>No Data Dream=1<br>No Elec Measurement=1<br>Temperature=220°C | 120 | Visual Inspection | | | 0/15 | 0/15 | | |
| | | | Metal (solder)=SnPb<br>No Data Dream=1<br>No Elec Measurement=1<br>Temperature=220°C<br>Wet Aging=8Hrs | | Visual Inspection | | | 0/15 | 0/15 | | |
| | | | Dry Aging=16Hrs<br>Metal (solder)=SnAgCu<br>No Data Dream=1<br>No Elec Measurement=1<br>Temperature=245°C | | Visual Inspection | | | 0/15 | 0/15 | | |
| | | | Metal (solder)=SnAgCu<br>No Data Dream=1<br>No Elec Measurement=1<br>Temperature=245°C<br>Wet Aging=8Hrs | | Visual Inspection | | | 0/15 | 0/15 | | |

| Test | PC | Std ref. | Conditions | Total | Steps | Results/Lot Fail/S.S. |
|---|---|---|---|---|---|---|
| | | | | | | GD 1 |
| Whiskers | N | JESD201 | No reflow<br>THS 30°C/60%RH | 45 | 4000h | 0/9 |
| | | | Reflow SnPb 215°C<br>THS 55°C/85%RH | | 4000h | 0/9 |
| | | | Reflow SnPb 215°C<br>TC -40°C – 85°C | | 1500cy | 0/9 |
| | | | Reflow SnPb 260°C<br>THS 55°C/85%RH | | 4000h | 0/9 |
| | | | Reflow SnPb 260°C<br>TC -40°C – 85°C | | 1500cy | 0/9 |

# 6 ANNEXES

## 6.1 Parametric Verifications

- Results on STTH1R06AFY product:

| TEST | VR | VR | VR | IR | IR |
|---|---|---|---|---|---|
| EQUIPMENT | TESEC_AMK | | | | |
| Condition 1 | -40°C | 25°C | 150°C | 25°C | 150°C |
| Condition 2 | | | | VR=600V | VR=600V |
| Min. Datasheet | *600V* | *600V* | *600V* | | |
| Typ. Datasheet | | | | | *10uA* |
| Max. Datasheet | | | | *1uA* | *75uA* |
| Comments | | | | | |
| UNIT | V | V | V | nA | uA |
| N | 20 | 20 | 20 | 20 | 20 |
| Min | 646.000 | 677.100 | 738.500 | 0.000 | 2.514 |
| Max | 688.300 | 732.500 | 798.500 | 31.300 | 3.290 |
| Avg. | 672.345 | 714.925 | 779.625 | 3.506 | 2.873 |

| TEST | VF | VF | RTH(J-L) | ESD_HBM | ESD_CDM |
|---|---|---|---|---|---|
| EQUIPMENT | TESEC_AMK | | AMK_RTH_Phase12 | ESS6008 | ESD-CDM TEST SYSTEM |
| Condition 1 | 25°C | 150°C | | 25°C | 25°C |
| Condition 2 | IF=1A | IF=1A | | | |
| Min. Datasheet | | | | | |
| Typ. Datasheet | | *1.08V* | | | |
| Max. Datasheet | *1.9V* | *1.4V* | *24°C/W* | | |
| Comments | | | | AEC-Q101 | AEC-Q101 |
| UNIT | V | V | °C/W | KV | KV |
| N | 20 | 20 | 10 | 30 | 30 |
| Min | 1.374 | 1.028 | 14.900 | 4 | >1.0 |
| Max | 1.544 | 1.121 | 16.190 | 4 | >1.0 |
| Avg. | 1.477 | 1.086 | 15.651 | 4 | |

- Results on STPS2H100ZF product:

| TEST | VF | VF | VF | VF | IR | IR |
|---|---|---|---|---|---|---|
| EQUIPMENT | TESEC_AMK | | | | | |
| Condition 1 | 24°C | 24°C | 125°C | 125°C | 24°C | 125°C |
| Condition 2 | IF=2A | IF=4A | IF=2A | IF=4A | VR=100V | VR=100V |
| Min. Datasheet | | | | | | |
| Typ. Datasheet | | | *0.65V* | *0.75V* | | *0.2mA* |
| Max. Datasheet | *0.86V* | *0.96V* | *0.7V* | *0.83V* | *1uA* | *0.5mA* |
| Comments | | | | | | |
| UNIT | V | V | V | V | nA | uA |
| N | 20 | 20 | 20 | 20 | 20 | 20 |
| Min | 0.786 | 0.853 | 0.635 | 0.707 | 78.020 | 123.700 |
| Max | 0.791 | 0.861 | 0.642 | 0.716 | 126.600 | 170.300 |
| Avg. | 0.789 | 0.857 | 0.640 | 0.713 | 90.865 | 136.840 |

| TEST | VR | VR | VR | RTH(J-L) | ESD_HBM | ESD_CDM |
|---|---|---|---|---|---|---|
| EQUIPMENT | TESEC_AMK | | | AMK_RTH_Phase12 | ESS6008 | ESD-CDM TEST SYSTEM |
| Condition 1 | -40°C | 24°C | 125°C | | 25°C | 25°C |
| Condition 2 | | | | | | |
| Min. Datasheet | *100V* | *100V* | *100V* | | | |
| Typ. Datasheet | | | | | | |
| Max. Datasheet | | | | *20°C/W* | | |
| Comments | | | | | AEC-Q101 | AEC-Q101 |
| UNIT | V | V | V | °C/W | KV | KV |
| N | 20 | 20 | 20 | 10 | 30 | 30 |
| Min | 118.500 | 125.700 | 137.700 | 13.180 | 6 | >1.0 |
| Max | 120.300 | 127.300 | 139.500 | 15.680 | 6 | >1.0 |
| Avg. | 119.365 | 126.435 | 138.650 | 14.176 | 6 | |

- Results on SM6F36AY product:

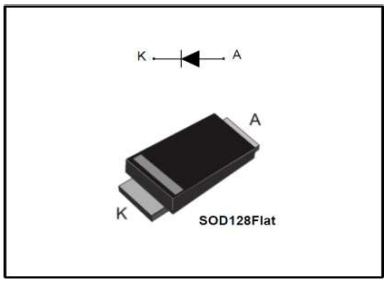
| TEST | IR | IR | VR | ESD_HBM | ESD_CDM | RTH(J-L) |
|---|---|---|---|---|---|---|
| EQUIPMENT | TSA_491 | | | ESS6008 | ESD-CDM TEST SYSTEM | RTH(PHASE12)_TEST417 |
| Condition 1 | 25°C | 85°C | 25°C | 25°C | 25°C | BARRE_ANALYSIS_TECH=S.U. |
| Condition 2 | VR=36V | VR=36V | IR=1000µA | | | BARRE_ST=S.U. |
| Min. Datasheet | | | *40V* | | | |
| Typ. Datasheet | | | *42.1V* | | | |
| Max. Datasheet | *200nA* | *1uA* | *44.2V* | | | |
| Comments | | | | AEC-Q101 | AEC-Q101 | |
| UNIT | nA | nA | V | KV | KV | °C/W |
| N | 20 | 20 | 20 | 30 | 30 | 5 |
| Min | 3.383 | 3.478 | 40.810 | >8.0 | >1.0 | 10.870 |
| Max | 83.790 | 7.295 | 42.710 | >8.0 | >1.0 | 12.490 |
| Avg. | 9.677 | 4.847 | 41.589 | | | 11.878 |

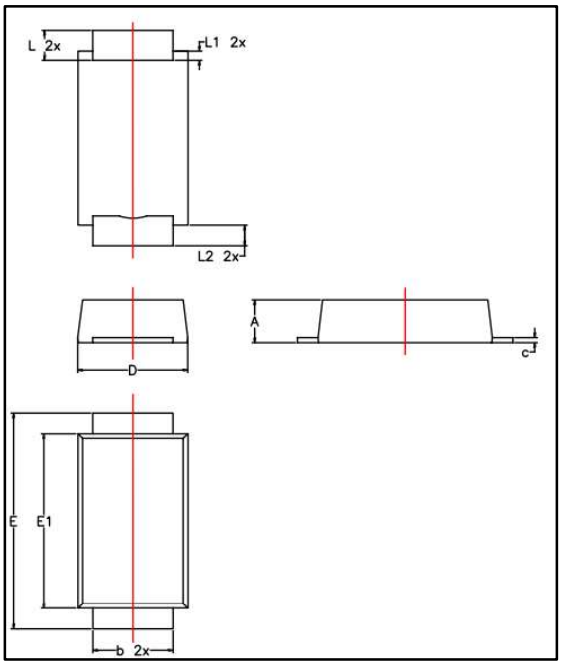
| TEST | VCL_10_1000 | RD | VCL_8_20 | RD | ALPHA_T |
|---|---|---|---|---|---|
| EQUIPMENT | VC6700 | TESTS_CALCULES | ARETI | TESTS_CALCULES | |
| Condition 1 | 25°C | 25°C | 25°C | 25°C | IR=1mA |
| Condition 2 | IPP=10.3A | IF1=5.2A | IPP=52A | IF1=26A | TJ1=25°C |
| Condition 3 | TP=1000us | IF2=10.3A | TP=20us | IF2=52A | TJ2=85°C |
| Condition 4 | TR=10us | VF1=10 - VCL_10_1000 V | TR=8us | VF1=16 - VCL_8_20 V | |
| Min. Datasheet | | | | | *1E-4/°C* |
| Typ. Datasheet | | | | | *1E-4/°C* |
| Max. Datasheet | *58.1V* | *1.35Ohm* | *76V* | *0.612Ohm* | *101E-4/°C* |
| Comments | | | | | |
| UNIT | V | Ohm | V | Ohm | 1E-4/°C |
| N | 10 | 10 | 10 | 10 | 20 |
| Min | 50.650 | 0.796 | 53.870 | 0.215 | 9.145 |
| Max | 53.540 | 1.061 | 54.400 | 0.246 | 9.445 |
| Avg. | 51.940 | 0.974 | 54.080 | 0.233 | 9.287 |

## 6.2 Physical Dimensions

# Dimensional report for SOD128 Flat package

| Ref. | Dimensions | |
|---|---|---|
| | Millimeters | |
| | Min. | Max. |
| A | 0.93 | 1.03 |
| b | 1.69 | 1.81 |
| c | 0.10 | 0.22 |
| D | 2.30 | 2.50 |
| E | 4.60 | 4.80 |
| E1 | 3.70 | 3.90 |
| L | 0.55 | 0.85 |
| L1 | 0.30 typ. | |
| L2 | 0.45 typ. | |

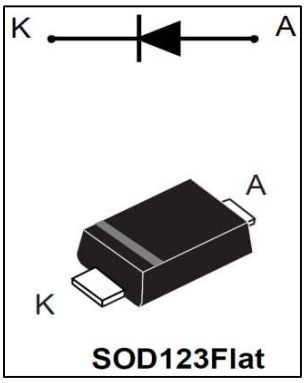


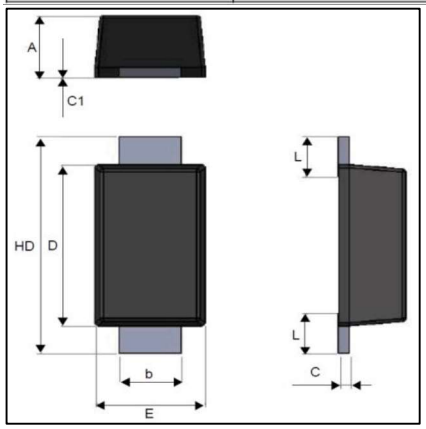




| Dimensions in mm | A | b | c | D | E | E1 | L | L1 | L2 |
|---|---|---|---|---|---|---|---|---|---|
| Measurement done on 30 units | | | | | | | | | |
| Min | 0.937 | 1.691 | 0.150 | 2.313 | 4.666 | 3.782 | 0.711 | 0.248 | 0.426 |
| Avg. | 0.955 | 1.712 | 0.160 | 2.401 | 4.685 | 3.817 | 0.743 | 0.277 | 0.466 |
| Max | 0.979 | 1.737 | 0.171 | 2.421 | 4.697 | 3.830 | 0.793 | 0.314 | 0.506 |
| LSL | 0.930 | 1.690 | 0.100 | 2.300 | 4.600 | 3.700 | 0.550 | | |
| Typ. | | | | | | | | 0.300 | 0.450 |
| USL | 1.030 | 1.810 | 0.220 | 2.500 | 4.800 | 3.900 | 0.850 | | |

# Dimensional report for SOD123 Flat package

| Ref. | Dimensions | | |
|---|---|---|---|
| | Millimeters | | |
| | Min. | Typ. | Max. |
| A | 0.86 | 0.98 | 1.10 |
| b | 0.80 | 0.90 | 1.00 |
| c | 0.08 | 0.15 | 0.25 |
| c1 | 0.00 | | 0.10 |
| D | 2.50 | 2.60 | 2.70 |
| E | 1.50 | 1.60 | 1.80 |
| HD | 3.30 | 3.50 | 3.70 |
| L | 0.45 | 0.65 | 0.85 |




| Dimensions in mm | A | b | c | c1 | D | E | HD | L |
|---|---|---|---|---|---|---|---|---|
| Measurement done on 30 units | | | | | | | | |
| Min | 0.944 | 0.902 | 0.135 | 0.022 | 2.603 | 1.573 | 3.445 | 0.632 |
| Avg. | 0.964 | 0.914 | 0.149 | 0.033 | 2.619 | 1.593 | 3.501 | 0.667 |
| Max | 0.989 | 0.929 | 0.167 | 0.044 | 2.648 | 1.672 | 3.586 | 0.707 |
| LSL | 0.860 | 0.800 | 0.080 | 0.000 | 2.500 | 1.500 | 3.300 | 0.450 |
| Typ. | 0.980 | 0.900 | 0.150 | | 2.600 | 1.600 | 3.500 | 0.650 |
| USL | 1.100 | 1.000 | 0.250 | 0.100 | 2.700 | 1.800 | 3.700 | 0.850 |

## 6.3 Tests description

| Test name | Description | Purpose |
|---|---|---|
| **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.<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. |
| **HTRB** High Temperature Reverse | The diode is biased in static reverse mode at 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.<br>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. |
| **H3TRB** Temperature Humidity 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. |
| **UHAST** Unbiased Highly Accelerated Stress Test | 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. |
| **IOLT** Intermittent Operating Life Test | All test samples shall be subjected to the specified number of cycles. When stabilized after initial warm-up cycles, a cycle shall consist of an "on" period, when power is applied suddenly to the device for the time necessary to achieve a delta case temperature (delta is the high minus the low mounting surface temperatures) of +85°C (+60°C for thyristors) +15°C, -5°C, followed by an off period, when the power is suddenly removed, for cooling the case through a similar delta temperature. | The purpose of this test is to determine compliance with the specified numbers of cycles for devices subjected to the specified conditions. It accelerates the stresses on all bonds and interfaces between the chip and mounting face of devices subjected to repeated turn on and off of equipment and is therefore most appropriate for case mount style (e.g., stud, flange, and disc) devices. |
| **RSH** Resistance to Solder Heat | Package is dipped by the leads in a solder bath after initial wet ageing (for SMDs only). Assessment by electrical test + no external crack | To simulate wave soldering process and verify that package will not be thermally damaged during this step. |
| **DPA** Destructive Physical Analysis | Specific construction analysis on random parts that have successfully completed H3TRB or TC. | To investigate on reliability stresses impact on delamination, corrosion and product construction integrity. |
| **SD** Solderability | The purpose of this test method is to provide a referee condition for the evaluation of the solderability of terminations (including leads up to 0.125 inch in diameter) that will be assembled using tin lead eutectic solder. | This evaluation is made on the basis of the ability of these terminations to be wetted and to produce a suitable fillet when coated by tin lead eutectic solder. These procedures will test whether the packaging materials and processes used during the manufacturing operations process produce a component that can be successfully soldered to the next level assembly using tin lead eutectic solder. A preconditioning test is included in this test method, which degrades the termination finish to provide a guard band against marginal finish. |
| **WG** Whiskers Growth | Forced growing of Tin Whiskers by various kind of environmental stress: temperature, moisture and temperature cycling. | To ensure no risk of electrical short due to Tin Whisker growth. |

# Qualification Report

*Molding compound replacement for SOD123Flat & SOD128Flat packages in Malaysia subcontractor for Rectifiers and Protection diodes*

| General Information | |
|---|---|
| **Product Line** | *Rectifiers* |
| **Product Description** | *Ultrafast, Power Schottky & Power Schottky Trench Diodes* |
| **Product perimeter** | *STPSxxxxZF / STTHxxxxZF*<br>*STPSTxxxxZF*<br>*STPSxxxxAF / STPSTxxxxAF*<br>*STTHxxxxAF* |
| **Product Group** | *ADG* |
| **Product division** | *Discrete & Filter* |
| **Package** | *SOD123-FLAT, SOD128-FLAT* |
| **Maturity level step** | *30* |

| Locations | |
|---|---|
| **Wafer fab** | *Tours 6 – France*<br>*Ang Mo Kio - Singapore* |
| **Assembly plant** | *Subcontractor 996I – Malaysia* |
| **Reliability Lab** | *ST TOURS - FRANCE* |
| **Reliability assessment** | *PASS* |

## DOCUMENT INFORMATION

| Version | Date | Pages | Prepared by | Approved by | Comments |
|---|---|---|---|---|---|
| 1.0 | 23-Nov-2023 | 20 | Yann TURIN | Christophe Goin<br>Digitally signed by Christophe Goin<br>Date: 2023.11.23 15:00:44 +01'00' | 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 |
| **AEC-Q005** | Pb-Free Test Requirements |

# 2 GLOSSARY

| | |
|---|---|
| **SS** | Sample Size |
| **PC** | Pre-Conditioning |
| **HTRB** | High Temperature Reverse Bias |
| **TC** | Temperature Cycling |
| **H3TRB** | High Humidity High Temperature Reverse Bias |
| **IOLT** | Intermittent Operating Life Test |
| **UHAST** | Unbiased Highly Accelerated Stress Test |
| **GD** | Generic Data |
| **SD** | Solderability test |
| **MSL** | Moisture Sensitivity Level |
| **WG** | Whiskers Growth |
| **Tj** | Junction Temperature |
| **BS** | Bond Shear |
| **WBS** | Wire Bond Strength |
| **RSH** | Resistance to Soldering Heat |

# 3 RELIABILITY EVALUATION OVERVIEW

## 3.1 Objectives

The objective of this report is to qualify new molding compound source for SOD123-FLAT and SOD128-FLAT packages.

The involved products are listed in the table here below:

| Product | Description | Package | Assembly Location |
|---|---|---|---|
| STPS1L40ZF<br>STPS1L60ZF<br>STPS2H100ZF | Power Schottky | SOD123-FLAT | Subcontractor 996I – Malaysia |
| STPS360AF<br>STPS3H100AF<br>STPS5H100AF | | SOD128-FLAT | |
| STPST1H100ZF<br>STPST2H100ZF | Power Schottky Trench | SOD123-FLAT | |
| STPST2H100AF<br>STPST1H100AF<br>STPST3H100AF<br>STPST5H100AF | | SOD128-FLAT | |
| STTH1R02ZF<br>STTH1R02ZF | Ultrafast | SOD123-FLAT | |
| STTH1R06AF | | SOD128-FLAT | |

The reliability test methodology used follows the ST 0061692 specification.

The following reliability tests ensuing are:

- TC and IOLT (only for rectifiers) 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, UHAST to check the robustness to corrosion and the good package hermeticity.
- RSH, Solderability to check compatibility of package with customer assembly.
- WG to check lead-finishing quality.

For some tests, similarity methodology is used. See 5.2 “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

Refer to ST specification (some examples below):

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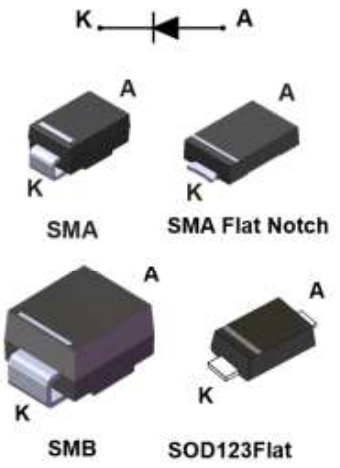
**STPS1L40**

Datasheet

40 V, 1 A low drop power Schottky rectifier




### Features

- Very small conduction losses
- Negligible switching losses
- Low forward voltage drop
- Surface mount miniature packages
- Avalanche rated
- ECOPACK2 compliant

### Applications

- Reverse polarity protection
- Set-top box power supply
- TV power supply
- Battery charger

### Description

Single chip Schottky rectifiers suited to switched mode power supplies and high frequency DC to DC converters.

Packaged in SMA, SMA Flat Notch, SMB and SOD123Flat, the STPS1L40 is ideal for use in surface mounting and used in low voltage, high frequency inverters, free-wheeling and polarity protection applications.

| Product status |
|---|
| STPS1L40 |

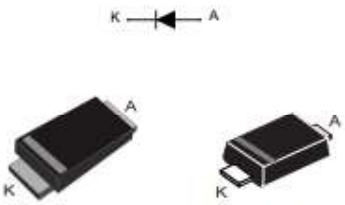
| Product summary | |
|---|---|
| **Symbol** | **Value** |
| $I_{F(AV)}$ | 1 A |
| $V_{RRM}$ | 40 V |
| $T_{j(max.)}$ | 175 °C |
| $V_{F(typ.)}$ | 0.37 V |

life.augmented

# STPST1H100

Datasheet

## 100 V - 1 A power Schottky trench rectifier




SOD128Flat SOD123Flat

STPOWER

**Product label**

SUSTAINABLE TECHNOLOGY

**Product status link**

STPST1H100

**Product summary**

| | |
|---|---|
| $I_{F(AV)}$ | 1 A |
| $V_{RRM}$ | 100 V |
| $T_j$ (max.) | 175 °C |
| $V_F$ (typ.) | 0.580 V |

## Features

- High junction temperature capability
- Low forward voltage drop
- Low recovery charges
- Reduces conduction, reverse and switching losses
- Avalanche tested
- Flat packages
- ECOPACK2 compliant

## Applications

- DC/DC converter
- LED lighting
- Flyback topology
- Auxiliary power supply
- Switch mode power supply (SMPS)

## Description

This 1 A, 100 V rectifier is based on ST trench technology that achieves the best-in-class $V_F/I_R$ trade-off for a given silicon surface.

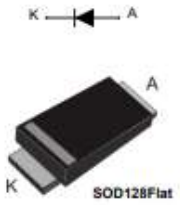
Integrated in flat and space-saving packages, this STPST1H100 trench rectifier is intended to be used in high frequency miniature switched mode power supplies. It is also an ideal candidate for auxiliary power supply in telecom, server, or smart metering. ST trench rectifiers are adapted to freewheeling, OR-ring or reverse polarity protection applications, and can be the perfect companion device to our transistors, drivers, or ST VIPer products.

life.augmented

# STTH1R06AF

Datasheet

## 600 V, 1 A, turbo 2 ultrafast rectifier




## Features

- Ultrafast recovery
- Low power losses
- High surge capability
- Low leakage current
- High junction temperature
- ECOPACK2 compliant component

## Applications

- Clamping function
- Boost diode
- PFC

| Product status |
|---|
| STTH1R06AF |

| Product summary | |
|---|---|
| $I_{F(AV)}$ | 1 A |
| $V_{RRM}$ | 600 V |
| $t_{rr}$ | 30 ns |
| $T_j$ | 175 °C |
| $V_{F(typ.)}$ | 1.08 V |

## Description

The STTH1R06AF is an ultrafast recovery power rectifier housed in SOD128Flat to improve space saving.

It is especially designed for clamping function in energy recovery block or boost diode in power correction circuitry.

The compromise between forward voltage drop and recovery time offers optimized performance.

## 4.2 Construction Note

| | *STPSxxxxZF - STPSxxxxAF* |
|---|---|
| **Wafer/Die fab. information** | |
| Wafer fab manufacturing location | Ang Mo Kio - Singapore |
| Technology / Process family | Power Schottky |
| **Wafer Testing (EWS) information** | |
| Electrical testing manufacturing location | Ang Mo Kio - Singapore |
| **Assembly information** | |
| Assembly site | Subcontractor – Malaysia (996I) |
| Package description | SOD123-Flat, SOD128-Flat |
| Molding compound | ECOPACK®2 |
| Lead finishing | Lead free (Pure Tin) |
| **Final testing information** | |
| Testing location | Subcontractor – Malaysia (996I) |

| | *STTHxxxxZF - STTHxxxxAF* |
|---|---|
| **Wafer/Die fab. information** | |
| Wafer fab manufacturing location | Tours - France |
| Technology / Process family | Rectifiers |
| **Wafer Testing (EWS) information** | |
| Electrical testing manufacturing location | Tours - France |
| **Assembly information** | |
| Assembly site | Subcontractor – Malaysia (996I) |
| Package description | SOD123-Flat, SOD128-Flat |
| Molding compound | ECOPACK®2 |
| Lead finishing | Lead free (Pure Tin) |
| **Final testing information** | |
| Testing location | Subcontractor – Malaysia (996I) |

| | *STPSTxxxxZF - STPSTxxxxAF* |
|---|---|
| **Wafer/Die fab. information** | |
| Wafer fab manufacturing location | Ang Mo Kio - Singapore |
| Technology / Process family | Power Schottky Trench |
| **Wafer Testing (EWS) information** | |
| Electrical testing manufacturing location | Ang Mo Kio - Singapore |
| **Assembly information** | |
| Assembly site | Subcontractor – China (998G) |
| Package description | SOD123-Flat, SOD128-Flat |
| Molding compound | ECOPACK®2 |
| Lead finishing | Lead free (Pure Tin) |
| **Final testing information** | |
| Testing location | Subcontractor – China (998G) |

# 5 TESTS RESULTS SUMMARY

## 5.1 Test vehicles

| Lot # | Part Number | Package | Comments |
|---|---|---|---|
| L11 | STPST2H100ZF | SOD 123 | Qualification lot |
| L13 | STTH1R06AFY | SOD 128 | Qualification lot |
| L19 | STTH1R02ZFY | SOD 123 | Qualification lot |
| L15 | STPS2H100ZF | SOD 123 | Qualification lot |
| L17 | STPS5H100AFY | SOD 128 | Qualification lot |
| GD1 | Dummies | SOD 128 | Generic data for whiskers test |

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 | JESD22A-113 | All qualification parts tested per the requirements of the appropriate device specification | | As per targeted MSL<br>Not applicable for PTH and WLCSP without coating | X |
| MSL research | MSL | J-STD-020 | L19, L17 | 60 | Not applicable for PTH and WLCSP without coating | X |
| 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 | All qualification parts tested per the requirements of the appropriate device specification | | | X |
| High Temperature Storage Life | HTSL | JESD22B-101 | | | Covered by HTRB | |
| Temperature Humidity Storage | THS | JESD22 A-118 | | | Covered by H3TRB | |
| High Temperature Gate Bias | HTGB | JESD22A-108 | | | Required for PowerMOSFET – IGBT only. | |
| High Temperature Reverse Bias | HTRB | JESD22A-108 | L13, L11, L15 | 231 | | X |
| High Temperature Forward Bias | HTFB | JESD22A-108 | | | Not required, applicable only to LEDS | |
| High Temperature Operating Life Test | HTOL | JESD22A-108 | | | Covered by HTRB. | |
| Steady State Operational | SSOP | MIL-STD-750-1 M1038 Test B | | | Required for Voltage Regulator (Zener) only. | |
| AC blocking voltage | ACBV | MIL-STD-750-1 M1040 Test A | | | Required for Thyristor only. | |
| Temperature Cycling | TC | JESD22A-104 | L13, L17, L15 | 231 | | 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. | |
| Wire Bond Integrity | WBI | MIL-STD-750 Method 2037 | | | For dissimilar metal bonding systems only | |
| Unbiased Highly Accelerated Stress Test | UHAST | JESD22A-118 | L19, L17, L15 | 231 | | X |
| Autoclave | AC | JESD22A-102 | | | Not recommended | |
| Highly Accelerated Stress Test | HAST | JESD22A-110 | | | Covered by H3TRB | |
| High Humidity High Temperature Reverse Bias | H3TRB | JESD22A-101 | L11, L19, L17, L15 | 308 | | X |
| High Temperature High Humidity Bias | HTHHB | JED22A-101 | | | Not required, LED only | |
| Intermittent Operational Life / Thermal Fatigue | IOL / TF | MIL-STD-750 Method 1037 | L13, L17, L15 | 231 | For power devices. Not required for Transient Voltage Suppressor (TVS) parts | X |
| Power and Temperature Cycle | PTC | JED22A-105 | | | Covered by IOL | |
| ESD Characterization | ESD HBM | AEC Q101-001 and 005 | | | For automotive products only | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Destructive Physical Analysis | DPA | AEC-Q101-004 Section 4 | | | After H3TRB and TC. For automotive products only | |
| Physical Dimension | PD | JESD22B-100 | GD | 60 | See Annexe 6.2 | X |
| 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) | L17, L15 | 60 | Not applicable for SMD pitch < 0.5mm, package size > 5.5*12.5mm and die paddle > 2.5*3.5mm | X |
| Solderability | SD | J-STD-002 JESD22B102 | L13, L15 | 120 | | X |
| Thermal Resistance | TR | JESD24-3, 24-4, 24-6 as appropriate | L13, L11 | 20 | Required in case of process change. See Annex 6.1 - RTH column | X |
| Wire Bond Strength | WBS | MIL-STD-750 Method 2037 | | | NA for products with clip | |
| Bond Shear | BS | AEC-Q101-003 | | | NA for products with clip | |
| 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 | GD1 | 45 | | X |
| Early Life Failure Rate | ELFR | JESD74 | | | Recommended for new techno development in case of identified failure mechanism | |
| Low Temperature Storage | LTS | JESD-22 A119: 209 | | | AQG324 test for Modules | |
| Thermal shock test | TST | JESD22-A104 | | | AQG324 test for Modules | |
| Power Cycling (seconds) | PCsec | MIL-STD750-1 Method1037 | | | AQG324 test for Modules | |
| Power Cycling (minutes) | PCmin | MIL-STD750-1 Method1037 | | | AQG324 test for Modules | |
| Mechanical shock | MS | IEC 600068-2-27 | | | AQG324 test for Modules | |
| Vibration | V | IEC60068-2-6 | | | AQG324 test for Modules | |
| Repetitive Surge | RS | Internal Specification | | | Only for TVS products | |

## 5.3 Results summary

| Test | PC | Std ref. | Conditions | Total | Steps | Results/Lot Fail/S.S. | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Lot 11 | Lot 19 | Lot 15 | Lot 13 | Lot 17 |
| Parametric Verifications | | ST datasheet | Over part temperature range | | - | Refer to paragraph 6.1 in Annexes | | | | |
| External Visual Inspection | | JESD22 B-101 | - | | - | All qualification parts submitted for testing passed External & Visual inspection during manufacturing process | | | | |
| Pre and Post Electrical Test | | ST datasheet | $I_R$, $V_F$ parameters following product datasheet | 1352 | - | 0/1352 | | | | |
| PC | | JESD22A-113 | Drying 24hrs; 125°C Storage 168hrs; 85°C;85%RH IR reflow 3 times | 1412 | - | 0/1121 | | | | |
| MSL1 research | Y | J-STD-020 | MSL=1, Reflow=3 Temperature=85°C Humidity (HR)=85% | 60 | - | | 0/30 | | | 0/30 |
| HTRB | N | JESD22-A108/MIL-STD-750-1 M1038 Method A | Junction Temperature=130°C Temperature=115°C Voltage=80V | 231 | 1000h | 0/77 | | 0/77 | | |
| | | | Junction Temperature=175°C Temperature=170°C Voltage=600V | | 1000h | | | | 0/77 | |
| | | | Junction Temperature=175°C Temperature=170°C Voltage=36V | | 1000h | | | | | |
| TC | Y | JESD22-A104 | Frequency (cy/h)=2cy/h Temperature (high)=150°C Temperature (low)=-55°C | 231 | 500cy | | | 0/77 | 0/77 | 0/77 |
| RSH | Y | JESD22A-111 (SMD) / JESD22B-106 (PTH) | Temperature=260°C Time (on)=10s | 60 | - | | | 0/30 | | 0/30 |
| H3TRB | Y | JESD22-A101 | Humidity (HR)=85% Temperature=85°C Voltage=80V | 308 | 500h | 0/77 | | 0/77 | | 0/77 |
| | | | Humidity (HR)=85% Temperature=85°C Voltage=100V | | 500h | | 0/77 | | | |
| | | | Humidity (HR)=85% Temperature=85°C Voltage=36V | | 500h | | | | | |
| uHAST | Y | JESD22 A-118 | Humidity (HR)=85% Pressure=2.3bar Temperature=130°C | 231 | 96h | | 0/77 | 0/77 | | 0/77 |
| IOLT | Y | MIL-STD 750 Method 1037 | Delta Tj=125°C Intensity (If)=0.8A Time (off)=120s Time (on)=120s | 231 | 500h | | | | 0/77 | |
| | | | Delta Tj=125°C Intensity (If)=1.45A Time (off)=120s Time (on)=120s | | 500h | | | 0/77 | | |
| | | | Delta Tj=125°C Intensity (If)=2.1A Time (off)=120s Time (on)=120s | | 500h | | | | | 0/77 |

| Test | PC | Std ref. | Conditions | Total | Steps | Results/Lot Fail/S.S. | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Lot 11 | Lot 19 | Lot 15 | Lot 13 | Lot 17 |
| SD | N | J-STD-002 | Dry Aging=16Hrs<br>Metal (solder)=SnPb<br>No Data Dream=1<br>No Elec Measurement=1<br>Temperature=220°C | 120 | Visual Inspection | | | 0/15 | 0/15 | |
| | | | Metal (solder)=SnPb<br>No Data Dream=1<br>No Elec Measurement=1<br>Temperature=220°C<br>Wet Aging=8Hrs | | Visual Inspection | | | 0/15 | 0/15 | |
| | | | Dry Aging=16Hrs<br>Metal (solder)=SnAgCu<br>No Data Dream=1<br>No Elec Measurement=1<br>Temperature=245°C | | Visual Inspection | | | 0/15 | 0/15 | |
| | | | Metal (solder)=SnAgCu<br>No Data Dream=1<br>No Elec Measurement=1<br>Temperature=245°C<br>Wet Aging=8Hrs | | Visual Inspection | | | 0/15 | 0/15 | |

| Test | PC | Std ref. | Conditions | Total | Steps | Results/Lot Fail/S.S. |
|---|---|---|---|---|---|---|
| | | | | | | GD 1 |
| Whiskers | N | JESD201 | No reflow<br>THS 30°C/60%RH | 45 | 4000h | 0/9 |
| | | | Reflow SnPb 215°C<br>THS 55°C/85%RH | | 4000h | 0/9 |
| | | | Reflow SnPb 215°C<br>TC -40°C – 85°C | | 1500cy | 0/9 |
| | | | Reflow SnPb 260°C<br>THS 55°C/85%RH | | 4000h | 0/9 |
| | | | Reflow SnPb 260°C<br>TC -40°C – 85°C | | 1500cy | 0/9 |

# 6 ANNEXES

## 6.1 Parametric Verifications

- Results on STTH1R06AFY product:

| TEST | VR | VR | VR | IR | IR |
|---|---|---|---|---|---|
| EQUIPMENT | TESEC_AMK | | | | |
| Condition 1 | -40°C | 25°C | 150°C | 25°C | 150°C |
| Condition 2 | | | | VR=600V | VR=600V |
| Min. Datasheet | *600V* | *600V* | *600V* | | |
| Typ. Datasheet | | | | | *10uA* |
| Max. Datasheet | | | | *1uA* | *75uA* |
| Comments | | | | | |
| UNIT | V | V | V | nA | uA |
| N | 20 | 20 | 20 | 20 | 20 |
| Min | 646.000 | 677.100 | 738.500 | 0.000 | 2.514 |
| Max | 688.300 | 732.500 | 798.500 | 31.300 | 3.290 |
| Avg. | 672.345 | 714.925 | 779.625 | 3.506 | 2.873 |

| TEST | VF | VF | RTH(J-L) |
|---|---|---|---|
| EQUIPMENT | TESEC_AMK | | AMK_RTH_Phase12 |
| Condition 1 | 25°C | 150°C | |
| Condition 2 | IF=1A | IF=1A | |
| Min. Datasheet | | | |
| Typ. Datasheet | | *1.08V* | |
| Max. Datasheet | *1.9V* | *1.4V* | *24°C/W* |
| Comments | | | |
| UNIT | V | V | °C/W |
| N | 20 | 20 | 10 |
| Min | 1.374 | 1.028 | 14.900 |
| Max | 1.544 | 1.121 | 16.190 |
| Avg. | 1.477 | 1.086 | 15.651 |

- Results on STPS2H100ZF product:

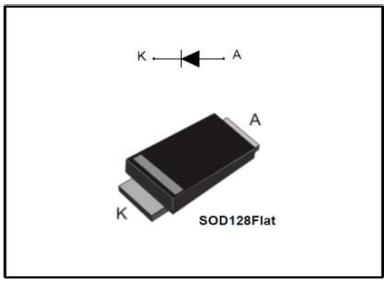
| TEST | VF | VF | VF | VF | IR | IR |
|---|---|---|---|---|---|---|
| EQUIPMENT | TESEC_AMK | | | | | |
| Condition 1 | 24°C | 24°C | 125°C | 125°C | 24°C | 125°C |
| Condition 2 | IF=2A | IF=4A | IF=2A | IF=4A | VR=100V | VR=100V |
| Min. Datasheet | | | | | | |
| Typ. Datasheet | | | *0.65V* | *0.75V* | | *0.2mA* |
| Max. Datasheet | *0.86V* | *0.96V* | *0.7V* | *0.83V* | *1uA* | *0.5mA* |
| Comments | | | | | | |
| UNIT | V | V | V | V | nA | uA |
| N | 20 | 20 | 20 | 20 | 20 | 20 |
| Min | 0.786 | 0.853 | 0.635 | 0.707 | 78.020 | 123.700 |
| Max | 0.791 | 0.861 | 0.642 | 0.716 | 126.600 | 170.300 |
| Avg. | 0.789 | 0.857 | 0.640 | 0.713 | 90.865 | 136.840 |

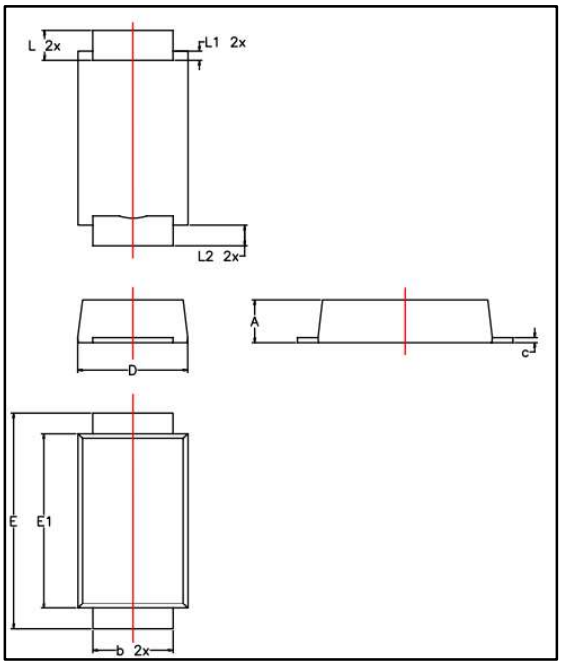
| TEST | VR | VR | VR | RTH(J-L) |
|---|---|---|---|---|
| EQUIPMENT | TESEC_AMK | | | AMK_RTH_Phase12 |
| Condition 1 | -40°C | 24°C | 125°C | |
| Condition 2 | | | | |
| Min. Datasheet | *100V* | *100V* | *100V* | |
| Typ. Datasheet | | | | |
| Max. Datasheet | | | | *20°C/W* |
| Comments | | | | |
| UNIT | V | V | V | °C/W |
| N | 20 | 20 | 20 | 10 |
| Min | 118.500 | 125.700 | 137.700 | 13.180 |
| Max | 120.300 | 127.300 | 139.500 | 15.680 |
| Avg. | 119.365 | 126.435 | 138.650 | 14.176 |

## 6.2 Physical Dimensions

# Dimensional report for SOD128 Flat package

| Ref. | Dimensions | |
|---|---|---|
| | Millimeters | |
| | Min. | Max. |
| A | 0.93 | 1.03 |
| b | 1.69 | 1.81 |
| c | 0.10 | 0.22 |
| D | 2.30 | 2.50 |
| E | 4.60 | 4.80 |
| E1 | 3.70 | 3.90 |
| L | 0.55 | 0.85 |
| L1 | 0.30 typ. | |
| L2 | 0.45 typ. | |

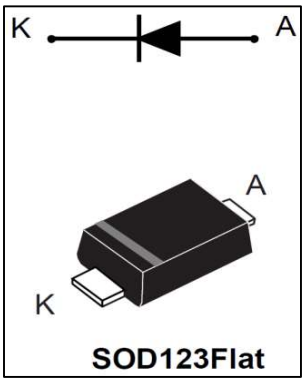


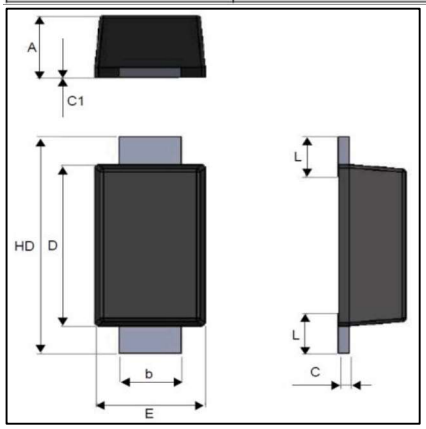




| Dimensions in mm | A | b | c | D | E | E1 | L | L1 | L2 |
|---|---|---|---|---|---|---|---|---|---|
| Measurement done on 30 units | | | | | | | | | |
| Min | 0.937 | 1.691 | 0.150 | 2.313 | 4.666 | 3.782 | 0.711 | 0.248 | 0.426 |
| Avg. | 0.955 | 1.712 | 0.160 | 2.401 | 4.685 | 3.817 | 0.743 | 0.277 | 0.466 |
| Max | 0.979 | 1.737 | 0.171 | 2.421 | 4.697 | 3.830 | 0.793 | 0.314 | 0.506 |
| LSL | 0.930 | 1.690 | 0.100 | 2.300 | 4.600 | 3.700 | 0.550 | | |
| Typ. | | | | | | | | 0.300 | 0.450 |
| USL | 1.030 | 1.810 | 0.220 | 2.500 | 4.800 | 3.900 | 0.850 | | |

# Dimensional report for SOD123 Flat package

| Ref. | Dimensions | | |
|---|---|---|---|
| | Millimeters | | |
| | Min. | Typ. | Max. |
| A | 0.86 | 0.98 | 1.10 |
| b | 0.80 | 0.90 | 1.00 |
| c | 0.08 | 0.15 | 0.25 |
| c1 | 0.00 | | 0.10 |
| D | 2.50 | 2.60 | 2.70 |
| E | 1.50 | 1.60 | 1.80 |
| HD | 3.30 | 3.50 | 3.70 |
| L | 0.45 | 0.65 | 0.85 |




| Dimensions in mm | A | b | c | c1 | D | E | HD | L |
|---|---|---|---|---|---|---|---|---|
| Measurement done on 30 units | | | | | | | | |
| Min | 0.944 | 0.902 | 0.135 | 0.022 | 2.603 | 1.573 | 3.445 | 0.632 |
| Avg. | 0.964 | 0.914 | 0.149 | 0.033 | 2.619 | 1.593 | 3.501 | 0.667 |
| Max | 0.989 | 0.929 | 0.167 | 0.044 | 2.648 | 1.672 | 3.586 | 0.707 |
| LSL | 0.860 | 0.800 | 0.080 | 0.000 | 2.500 | 1.500 | 3.300 | 0.450 |
| Typ. | 0.980 | 0.900 | 0.150 | | 2.600 | 1.600 | 3.500 | 0.650 |
| USL | 1.100 | 1.000 | 0.250 | 0.100 | 2.700 | 1.800 | 3.700 | 0.850 |

## 6.3 Tests description

| Test name | Description | Purpose |
|---|---|---|
| **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.<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. |
| **HTRB** High Temperature Reverse | The diode is biased in static reverse mode at 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.<br>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. |
| **H3TRB** Temperature Humidity 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. |
| **UHAST** Unbiased Highly Accelerated Stress Test | 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. |
| **IOLT** Intermittent Operating Life Test | All test samples shall be subjected to the specified number of cycles. When stabilized after initial warm-up cycles, a cycle shall consist of an "on" period, when power is applied suddenly to the device for the time necessary to achieve a delta case temperature (delta is the high minus the low mounting surface temperatures) of +85°C (+60°C for thyristors) +15°C, -5°C, followed by an off period, when the power is suddenly removed, for cooling the case through a similar delta temperature. | The purpose of this test is to determine compliance with the specified numbers of cycles for devices subjected to the specified conditions. It accelerates the stresses on all bonds and interfaces between the chip and mounting face of devices subjected to repeated turn on and off of equipment and is therefore most appropriate for case mount style (e.g., stud, flange, and disc) devices. |
| **RSH** Resistance to Solder Heat | Package is dipped by the leads in a solder bath after initial wet ageing (for SMDs only). Assessment by electrical test + no external crack | To simulate wave soldering process and verify that package will not be thermally damaged during this step. |
| **SD** Solderability | The purpose of this test method is to provide a referee condition for the evaluation of the solderability of terminations (including leads up to 0.125 inch in diameter) that will be assembled using tin lead eutectic solder. | This evaluation is made on the basis of the ability of these terminations to be wetted and to produce a suitable fillet when coated by tin lead eutectic solder. These procedures will test whether the packaging materials and processes used during the manufacturing operations process produce a component that can be successfully soldered to the next level assembly using tin lead eutectic solder. A preconditioning test is included in this test method, which degrades the termination finish to provide a guard band against marginal finish. |
| **WG** Whiskers Growth | Forced growing of Tin Whiskers by various kind of environmental stress: temperature, moisture and temperature cycling. | To ensure no risk of electrical short due to Tin Whisker growth. |