# PRODUCT / PROCESS CHANGE NOTIFICATION

## 1. PCN basic data

<table>
<thead>
<tr>
<th>1.1 Company</th>
<th>STMicroelectronics International N.V</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.2 PCN No.</td>
<td>AMS/20/12144</td>
</tr>
<tr>
<td>1.3 Title of PCN</td>
<td>New assembly site for General Purpose Analog products in MiniSO8 package</td>
</tr>
<tr>
<td>1.4 Product Category</td>
<td>See product list</td>
</tr>
<tr>
<td>1.5 Issue date</td>
<td>2020-05-14</td>
</tr>
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## 2. PCN Team

<table>
<thead>
<tr>
<th>2.1 Contact supplier</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1.1 Name</td>
<td>ROBERTSON HEATHER</td>
</tr>
<tr>
<td>2.1.2 Phone</td>
<td>+1 8475853058</td>
</tr>
<tr>
<td>2.1.3 Email</td>
<td><a href="mailto:heather.robertson@st.com">heather.robertson@st.com</a></td>
</tr>
</tbody>
</table>

## 2. Change responsibility

<table>
<thead>
<tr>
<th>2.2.1 Product Manager</th>
<th>Domenico ARRIGO, Marcello SAN BIAGIO</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.2.2 Marketing Manager</td>
<td>Fulvio PULICELLI, Salvatore DI VINCENZO</td>
</tr>
<tr>
<td>2.2.3 Quality Manager</td>
<td>Alessandro PLATINI, Jean-Marc BUGNARD</td>
</tr>
</tbody>
</table>

## 3. Change

<table>
<thead>
<tr>
<th>3.1 Category</th>
<th>3.2 Type of change</th>
<th>3.3 Manufacturing Location</th>
</tr>
</thead>
</table>
| Transfer     | Line transfer for a full process or process brick (process step, control plan, recipes) from one site to another site: Assembly site (SOP 2617) | Assembly plant:  
- TSHT China  
- Amkor Philippines  
- Carsem Malaysia |

## 4. Description of change

<table>
<thead>
<tr>
<th>4.1 Description</th>
<th>Old</th>
<th>New</th>
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</thead>
<tbody>
<tr>
<td>Assembly plant:</td>
<td>- Amkor Philippines</td>
<td>- TSHT China</td>
</tr>
<tr>
<td>- Carsem Malaysia</td>
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<td>- Amkor Philippines</td>
</tr>
<tr>
<td>- Carsem Malaysia</td>
<td></td>
<td>- Carsem Malaysia</td>
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</table>

| 4.2 Anticipated Impact on form, fit, function, quality, reliability or processability? | No impact |

## 5. Reason / motivation for change

<table>
<thead>
<tr>
<th>5.1 Motivation</th>
<th>The purpose of the introduction of TSHT for both Assy and Test &amp; Finishing activities is to further improve the rationalization of our manufacturing assets and provide a better support to our customers by enhancing the manufacturing process for higher volume production.</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.2 Customer Benefit</td>
<td>SERVICE IMPROVEMENT</td>
</tr>
</tbody>
</table>

## 6. Marking of parts / traceability of change

<table>
<thead>
<tr>
<th>6.1 Description</th>
<th>New Finished good codes</th>
</tr>
</thead>
</table>

## 7. Timing / schedule

| 7.1 Date of qualification results | 2020-04-30 |
| 7.2 Intended start of delivery   | 2020-08-15 |
| 7.3 Qualification sample available? | Upon Request |

## 8. Qualification / Validation

<table>
<thead>
<tr>
<th>8.1 Description</th>
<th>12144 PCN standard-MiniISO TSHT.pdf</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.2 Qualification report and qualification results</td>
<td>Available (see attachment)</td>
</tr>
</tbody>
</table>
### 9. Attachments (additional documentations)

- 12144 Public product.pdf
- 12144 PCN standard-MiniISO TSHT.pdf

### 10. Affected parts

<table>
<thead>
<tr>
<th>10.1.1 Customer Part No</th>
<th>10.1.2 Supplier Part No</th>
<th>10.2 New (if applicable)</th>
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<tbody>
<tr>
<td>LM258AST</td>
<td>LM2903ST</td>
<td></td>
</tr>
<tr>
<td>LM2904ST</td>
<td>LM2904ST</td>
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<td>LM293ST</td>
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<tr>
<td>LM358ST</td>
<td>LM358WST</td>
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<td>LM393ST</td>
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Analog, MEMS & Sensors (AMS)

New assembly site for General Purpose Analog products in MiniSO8 packages
WHAT:

Progressing on activities related to process modernization and quality improvement, ST is pleased to announce the introduction of TSHT/China as an added subcontractor for Assy and Test & Finishing activities for some products assembled in our MiniSO8 package.

Please find more information related to material change in the table here below

<table>
<thead>
<tr>
<th>Material</th>
<th>Current process</th>
<th>Modified process</th>
<th>Comment</th>
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<tbody>
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<td>Diffusion location</td>
<td>ST Ang Mo Kio (Singapore)/UMC/ST Agrate</td>
<td>ST Ang Mo Kio (Singapore)/UMC/ST Agrate</td>
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</tr>
<tr>
<td>Assembly location</td>
<td>Amkor Philippines/Carsem Malaysia</td>
<td>TSHT China</td>
<td></td>
</tr>
<tr>
<td>Molding compound</td>
<td>Sumitomo G700/Hitachi CEL 8240</td>
<td>Hitachi CEL 9220</td>
<td></td>
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<tr>
<td>Die attach</td>
<td>Henkel 8290/QMI519</td>
<td>Henkel 8200T/Henkel8600</td>
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<tr>
<td>Leadframe</td>
<td>Copper</td>
<td>Copper</td>
<td></td>
</tr>
<tr>
<td>Plating</td>
<td>NiPdAu/Matte Sn</td>
<td>Matte Sn</td>
<td></td>
</tr>
<tr>
<td>Wire</td>
<td>Gold 1.2Mils/1mil/0.8Mil</td>
<td>Gold 1.3mils/Copper Pd coated 1 mil</td>
<td></td>
</tr>
</tbody>
</table>

WHY:

The purpose of the introduction of TSHT for both Assy and Test & Finishing activities for the here above listed commercial products is to further improve the rationalization of our manufacturing assets and provide a better support to our customers by enhancing the manufacturing process for higher volume production.

HOW:

The qualification program consists mainly of comparative electrical characterization and reliability tests.

You will find here after the qualification test plan which summarizes the various test methods and conditions that ST uses for this qualification program.

WHEN:

The new material set will be implemented in Q2/2020 in TSHT China.

Marking and traceability:

Unless otherwise stated by customer’s specific requirement, the traceability of the parts assembled with the new material set will be ensured by new internal sales type, date code and lot number.

The changes here reported will not affect the electrical, dimensional and thermal parameters keeping unchanged all the information reported on the relevant datasheets.

There is -as well- no change in the packing process or in the standard delivery quantities. Shipments may start earlier with the customer’s written agreement.
Reliability Qualification plan  
*AMS Back-end qualification*  
*MSOP 8*  
*Production transfer to TSHT*

### General Information

<table>
<thead>
<tr>
<th>Product Line</th>
<th>0193, 0358, V992, UY36, UQ18</th>
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</thead>
<tbody>
<tr>
<td>Product Description</td>
<td>Dual comparator bipolar, Dual op amp bipolar, Dual op amp, biCMOS, Dual precision op amp, 4A dual low-side MOSFET driver</td>
</tr>
<tr>
<td>P/N</td>
<td>LM2903WST, LM2904WST, TSV992IST, TSX7192IST, PM8834</td>
</tr>
<tr>
<td>Product Group</td>
<td>AMS</td>
</tr>
<tr>
<td>Product division</td>
<td>General Purpose Analog &amp; RF</td>
</tr>
<tr>
<td>Package</td>
<td>MiniSO8, MiniSO8 exposed pad</td>
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<tr>
<td>Silicon Process technology</td>
<td>Bipolar, HF5CMOS, HVG8A</td>
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</table>

### Locations

<table>
<thead>
<tr>
<th>Wafer fab</th>
<th>ST Singapore, UMC, ST Agrate</th>
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<tbody>
<tr>
<td>Assembly plant</td>
<td>TSHT China</td>
</tr>
<tr>
<td>Reliability Lab</td>
<td>ST Grenoble, TSHT</td>
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</tbody>
</table>

Note: This report is a summary of the reliability trials performed in good faith by STMicroelectronics in order to evaluate the potential reliability risks during the product life using a set of defined test methods. This report does not imply for STMicroelectronics expressly or implicitly any contractual obligations other than as set forth in STMicroelectronics general terms and conditions of Sale. This report and its contents shall not be disclosed to a third party without previous written agreement from STMicroelectronics.
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   6.2 TESTS DESCRIPTION ......................................................................................... 17
1 APPLICABLE AND REFERENCE DOCUMENTS

<table>
<thead>
<tr>
<th>Document reference</th>
<th>Short description</th>
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</thead>
<tbody>
<tr>
<td>JESD47</td>
<td>Stress-Test-Driven Qualification of Integrated Circuits</td>
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</table>

2 GLOSSARY

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>DUT</td>
<td>Device Under Test</td>
</tr>
<tr>
<td>PCB</td>
<td>Printed Circuit Board</td>
</tr>
<tr>
<td>SS</td>
<td>Sample Size</td>
</tr>
</tbody>
</table>

3 RELIABILITY EVALUATION OVERVIEW

3.1 Objectives

To qualify a new assembly site, TSHT China, for products in MiniSO8 package for Analog products.

3.2 Conclusion

Qualification Plan requirements have to be fulfilled without issue. It is stressed that reliability tests have to show that the devices behave correctly against environmental tests (no failure). Moreover, the stability of electrical parameters during the accelerated tests have to demonstrate the ruggedness of the products and safe operation, which is consequently expected during their lifetime.
4 DEVICE CHARACTERISTICS

4.1 Device description

LM2903WST

Low-power, dual-voltage comparator

Features
- Wide, single supply voltage range or dual supplies ±2 V to ±36 V or ±1 V to ±18 V
- Very low supply current (0.4 mA) independent of supply voltage (1 mW/comparator at +5 V)
- Low input bias current: 25 nA typ.
- Low input offset current: ±5 nA typ.
- Input common-mode voltage range includes negative rail
- Low output saturation voltage: 250 mV typ. (I_{O} = 4 mA)
- Differential input voltage range equal to the supply voltage
- TTL, DTL, ECL, MOS, CMOS compatible outputs
- ESD internal protection: 2 kV

Description
This device consists of two independent low-power voltage comparators designed specifically to operate from a single supply over a wide range of voltages. Operation from split power supplies is also possible.

The input common-mode voltage range includes negative rail even though operated from a single power supply voltage.

All pins are protected against electrostatic discharge up to 2 kV. Consequently, the input voltages must not exceed the $V_{CC}$ or $V_{CC'}$ magnitudes.
LM2904WST,

LM2904, LM2904A
LM2904W, LM2904AW

Low-power dual operational amplifier

Features
- Frequency compensation implemented internally
- Large DC voltage gain: 100 dB
- Wide bandwidth (unity gain): 1.1 MHz (temperature compensated)
- Very low supply current amplifier, essentially independent of supply voltage
- Low input bias current: 20 nA (temperature compensated)
- Low input offset current: 2 nA
- Input common-mode voltage range includes negative rail
- Differential input voltage range equal to the power supply voltage
- Large output voltage swing 0 V to [VCC - 1.5 V]

Description
This circuit consists of two independent, high gain operational amplifiers (op amps) that have frequency compensation implemented internally. They are designed specifically for automotive and industrial control systems. The circuit operates from a single power supply over a wide range of voltages. The low power supply drain is independent of the magnitude of the power supply voltage.

Application areas include transducer amplifiers. DC gain blocks and all the conventional op amp circuits which can now be more easily implemented in single power supply systems. For example, these circuits can be directly supplied from the standard 5 V which is used in logic systems and easily provides the required electronic interfaces without requiring any additional power supply.

In linear mode, the input common-mode voltage range includes ground and the output voltage can also swing to ground, even though operated from a single power supply.

<table>
<thead>
<tr>
<th>Maturity status link</th>
<th>Enhanced Vg</th>
<th>Enhanced EXD</th>
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</tr>
<tr>
<td>LM2904A</td>
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<tr>
<td>LM2904W</td>
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<td>✓</td>
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<tr>
<td>LM2904AW</td>
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<td>✓</td>
</tr>
</tbody>
</table>

Related products:
- TDB572: Dual op-amps for low-power consumption (300 μA with 2.5 MHz GMP)
- LM2902, LM2902W: Quad op-amps version
- LM2904W, LM2904AH: High temperature version (150 °C)
TSV992ST

TSV991, TSV992, TSV994 TSV991A
TSV992A, TSV994A
Datasheet

Rail-to-rail input/output 20 MHz GBP operational amplifiers

Features
- Low input offset voltage: 1.5 mV max. (A grade)
- Rail-to-rail input and output
- Wide bandwidth 20 MHz
- Stable for gain ± 4 or ± 3
- Low power consumption: 320 µA typ.
- High output current: 35 mA
- Operating from 2.6 V to 6.5 V
- Low input bias current, 1 µA typ.
- ESD internal protection ≥ 5 kV

Applications
- Battery-powered applications
- Portable devices
- Signal conditioning and active filtering
- Medical instrumentation
- Automotive applications

Description
The TSV99x and TSV99xA family of single, dual, and quad operational amplifiers offers low voltage operation and rail-to-rail input and output. These devices feature an excellent speed/power consumption ratio, offering a 20 MHz gain bandwidth, stable for gains above 4 (100 pF capacitive load), while consuming only 1.1 mA maximum at 5 V. They also feature an ultra-low input bias current. These characteristics make the TSV99x family ideal for sensor interfaces, battery-supplied and portable applications, as well as active filtering. These characteristics make the TSV99x, TSV99xA family ideal for sensor interfaces, battery-supplied and portable applications, as well as active filtering.
TSX7192ST

TSX7192

Low-power, precision, rail-to-rail, 9.0 MHz, 16 V operational amplifiers

Description
The TSX7192 dual, operational amplifier (op amp) offers high precision functioning with low input offset voltage down to a maximum of 200 μV at 25 °C. In addition, its rail-to-rail input and output functionality allows this product to be used on full range input and output without limitation. This is particularly useful for a low-voltage supply such as 2.7 V that the TSX7192 is able to operate with.

Thus, the TSX7192 has the great advantage of offering a large span of supply voltages, ranging from 2.7 V to 18 V. It can be used in multiple applications with a unique reference.

Low input bias current performance makes the TSX7192 perfect when used for signal conditioning in sensor interface applications. In addition, low-side and high-side current measurements can be easily made thanks to rail-to-rail functionality. The TSX7192 is a decompensated amplifier and must be used with a gain greater than 10 to ensure stability.

High ESD tolerance (4 kV HBM) and a wide temperature range are also good arguments to use the TSX7192 in the automotive market segment.

Features
- Low input offset voltage: 200 μV max.
- Rail-to-rail input and output
- Low current consumption: 550 μA max.
- Gain bandwidth product: 9 MHz
- Low supply voltage: 2.7 to 10 V
- Stable when used with Gain ≥ 10
- Low input bias current: 50 pA max.
- High ESD tolerance: 4 kV HBM
- Extended temp. range: -40 °C to 125 °C
- Automotive qualification

Related products
- See the TSX7191 for single op amp version
- See the TSX712 for lower speeds with similar precision
- See the TSX802 for low-power features
- See the TSX932 for micro-power features
- See the TSX822 for higher speeds

Applications
- Battery-powered instrumentation
- Instrumentation amplifier
- Active filtering
- High-impedance sensor interface
- Current sensing (high and low side)
PM8834

**PM8834**

4 A dual low-side MOSFET driver

Datasheet - production data

**Applications**
- SMPS
- DC-DC converters
- Motor controllers
- Line drivers
- Class-D switching amplifiers

**Features**
- Dual independent low-side MOSFET driver with 4 A sink and source capability
- Independent enable for each driver
- Driver output parallelability to support higher driving capability
- Matched propagation delays
- CMOS/TTL-compatible input levels
- Wide input supply voltage range: 5 V to 18 V
- Embedded drivers with anti cross conduction protection
- Low bias switching current
- Short propagation delays
- Rated for a wide operating temperature range: -40 °C to 125 °C
- Industry standard SO8 package and MSOP8 with exposed pad

**Description**
The PM8834 is a flexible, high-frequency dual low-side driver specifically designed to work with high capacitive MOSFETs and IGBTs.

Both PM8834 outputs can sink and source 4 A independently. A higher driving current can be obtained by connecting the two PWM outputs in parallel.

The PM8834 provides two enable pins which can be used to enable the operation of one or both of the output lines.

The PM8834 works with a CMOS/TTL-compatible PWM signal.

The device is available in an SO8 or an MSOP8 package with an exposed pad.

<table>
<thead>
<tr>
<th>Order code</th>
<th>Package</th>
<th>Packing</th>
</tr>
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<tbody>
<tr>
<td>PM8834</td>
<td>SO8</td>
<td>Tube</td>
</tr>
<tr>
<td>PM8834TR</td>
<td>SO8</td>
<td>Tape and reel</td>
</tr>
<tr>
<td>PM8834M</td>
<td>MSOP 8L-EP</td>
<td>Tube</td>
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<tr>
<td>PM8834RMTR</td>
<td>MSOP 8L-EP</td>
<td>Tape and reel</td>
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### 4.2 Construction note

<table>
<thead>
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<th>LM2903WST</th>
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<th>TSV992IST</th>
<th>TSX792IST</th>
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<tr>
<td>Wafer fab manufacturing location</td>
<td>ST Singapore</td>
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<td>ST Singapore</td>
<td>UMC Taiwan</td>
<td>Catania</td>
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<td>Bipolar</td>
<td>HF2CMOS</td>
<td>HF3CMOS</td>
<td>BCD6S</td>
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<td>RAW SILICON</td>
<td>RAW SILICON</td>
<td>RAW SILICON</td>
<td>CHROMIUM/NICKEL/GOLD</td>
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# 5 TESTS PLAN SUMMARY

## 5.1 Test vehicle

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<tr>
<th>Lot #</th>
<th>Process/ Package</th>
<th>Product Line</th>
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<td>HF5CMOS/MiniSO8</td>
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<td>HVG8A/MiniSO8</td>
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<td>BCD6S/MiniSO8ePad</td>
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## 5.2 Test plan summary

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<th>PC</th>
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<td>Drying 24 H @ 125°C Store 168 H @ Ta=85°C Rh=85% Over Reflow @ Tpeak=260°C 3 times</td>
<td>96 H</td>
<td>Final Below sample + 22units Below sample + 22units Below sample + 22units Below sample + 22units Below sample + 22units 3x77</td>
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<td>JESD22 A-102</td>
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<tr>
<td>TC</td>
<td>Y</td>
<td>JESD22 A-101</td>
<td>Ta = 85°C, RH = 85%, BIAS</td>
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### 6 ANNEXES

#### 6.1 Tests Description

<table>
<thead>
<tr>
<th>Test name</th>
<th>Description</th>
<th>Purpose</th>
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<tbody>
<tr>
<td><strong>Die Oriented</strong></td>
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<td></td>
</tr>
<tr>
<td><strong>HTOL</strong></td>
<td>High Temperature Operating Life</td>
<td>To determine the effects of bias conditions and temperature on solid state devices over time. It simulates the devices’ operating condition in an accelerated way. The typical failure modes are related to, silicon degradation, wire-bonds degradation, oxide faults.</td>
</tr>
<tr>
<td>HTB</td>
<td>High Temperature Bias</td>
<td></td>
</tr>
<tr>
<td><strong>HTRB</strong></td>
<td>High Temperature Reverse Bias</td>
<td>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. 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.</td>
</tr>
<tr>
<td><strong>HTFB / HTGB</strong></td>
<td>High Temperature Forward (Gate) Bias</td>
<td>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. 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.</td>
</tr>
<tr>
<td><strong>HTSL</strong></td>
<td>High Temperature Storage Life</td>
<td>To investigate the failure mechanisms activated by high temperature, typically wire-bonds solder joint ageing, data retention faults, metal stress-voiding.</td>
</tr>
<tr>
<td><strong>ELFR</strong></td>
<td>Early Life Failure Rate</td>
<td>To evaluate the defects inducing failure in early life.</td>
</tr>
<tr>
<td><strong>Package Oriented</strong></td>
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<td></td>
</tr>
<tr>
<td><strong>PC</strong></td>
<td>Preconditioning</td>
<td>As stand-alone test: to investigate the moisture sensitivity level. As preconditioning before other reliability tests: to verify that the surface mounting stress does not impact on the subsequent reliability performance. The typical failure modes are &quot;pop corn&quot; effect and delamination.</td>
</tr>
<tr>
<td><strong>AC</strong></td>
<td>Auto Clave (Pressure Pot)</td>
<td>To investigate corrosion phenomena affecting die or package materials, related to chemical contamination and package hermeticity.</td>
</tr>
<tr>
<td><strong>TC</strong></td>
<td>Temperature Cycling</td>
<td>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.</td>
</tr>
<tr>
<td>Test name</td>
<td>Description</td>
<td>Purpose</td>
</tr>
<tr>
<td>-----------</td>
<td>-------------</td>
<td>---------</td>
</tr>
<tr>
<td><strong>TF / IOL</strong>&lt;br&gt;Thermal Fatigue / Intermittent Operating Life</td>
<td>The device is submitted to cycled temperature excursions generated by power cycles (ON/OFF) at $T_{ambient}$.</td>
<td>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.</td>
</tr>
<tr>
<td><strong>THB</strong>&lt;br&gt;Temperature Humidity Bias</td>
<td>The device is biased in static configuration minimizing its internal power dissipation, and stored at controlled conditions of ambient temperature and relative humidity.</td>
<td>To evaluate the package moisture resistance with electrical field applied, both electrolytic and galvanic corrosion are put in evidence.</td>
</tr>
<tr>
<td><strong>ESD</strong>&lt;br&gt;Electro Static Discharge</td>
<td>The device is submitted to a high voltage peak on all his pins simulating ESD stress according to different simulation models. CBM: Charged Device Model HBM: Human Body Model MM: Machine Model</td>
<td>To classify the device according to his susceptibility to damage or degradation by exposure to electrostatic discharge.</td>
</tr>
<tr>
<td><strong>LU</strong>&lt;br&gt;Latch-Up</td>
<td>The device is submitted to a direct current forced/sunk into the input/output pins. Removing the direct current no change in the supply current must be observed.</td>
<td>To verify the presence of bulk parasitic effect inducing latch-up.</td>
</tr>
</tbody>
</table>
Public Products List
Public Products are off the shelf products. They are not dedicated to specific customers, they are available through ST Sales team, or Distributors, and visible on ST.com

PCN Title : New assembly site for General Purpose Analog products in MiniSO8 package
PCN Reference : AMS/20/12144

Subject : Public Products List

Dear Customer,

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

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<th>TSV6192AIST</th>
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