**PRODUCT/PROCESS**
CHANGE NOTIFICATION

PCN AMS/20/12425

# Analog, MEMS & Sensors (AMS)

## New assembly site for Standard products (General Purpose Analog) assembled in MiniSO8 packages

**WHAT:**

Progressing on activities related to process modernization and quality improvement, ST is pleased to announce the introduction of TSHT/China (subcontractor) for Assy and Test & Finishing activities for some products assembled in our MiniSO8 package for analog products.
The Assembly production will gradually be transferred from Amkor (current subcontractor) to TSHT China.

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

| Material | Current process | Modified process | Comment |
|---|---|---|---|
| Diffusion location | ST Ang Mo Kio (Singapore)/ UMC / ST Agrate | ST Ang Mo Kio (Singapore)/ UMC / ST Agrate | |
| Assembly location | Amkor Philippines | TSHT China | |
| Molding compound | Sumitomo G700 | Hitachi CEL 9220 | |
| Die attach | Henkel 8290 | Henkel 8200T/Henkel8600 | |
| Leadframe | Copper | Copper | |
| Plating | NiPdAu | Matte Sn | |
| Wire | Gold 0.8Mil | Copper Pd coated 1 mil | |
| Appearance | | | |

**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 delivery support to our customers.

**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 Q1/2021 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 | |
|---|---|
| **Product Line** | *0193, 0358, V992, UY32, VB2F* |
| **Product Description** | Dual comparator bipolar, Dual op amp bipolar, , Dual op amp, biCMOS, Dual precision op amp, 4 A dual low-side, High bandwidth (50MHz) Low offset (250µV) Op amp |
| **P/N** | *LM2903WST, LM2904WST, TSV992IST, TSX922IST, TSV792IYST* |
| **Product Group** | *AMS* |
| **Product division** | *General Purpose Analog &RF* |
| **Package** | *MiniSO8* |
| **Silicon Process technology** | *Bipolar, HF5CMOS, HVG8A, HCMOS7* |

| Locations | |
|---|---|
| **Wafer fab** | *ST Singapore UMC, ST Agrate, ST Crolles* |
| **Assembly plant** | *TSHT China* |
| **Reliability Lab** | *ST Grenoble, TSHT* |

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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# 1 APPLICABLE AND REFERENCE DOCUMENTS

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

# 2 GLOSSARY

| | |
|---|---|
| **DUT** | Device Under Test |
| **PCB** | Printed Circuit Board |
| **SS** | Sample Size |
| | |

# 3 RELIABILITY EVALUATION OVERVIEW

## 3.1 Objectives

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

# LM2903W

Low-power, dual-voltage comparator

**Datasheet — production data**

### Features

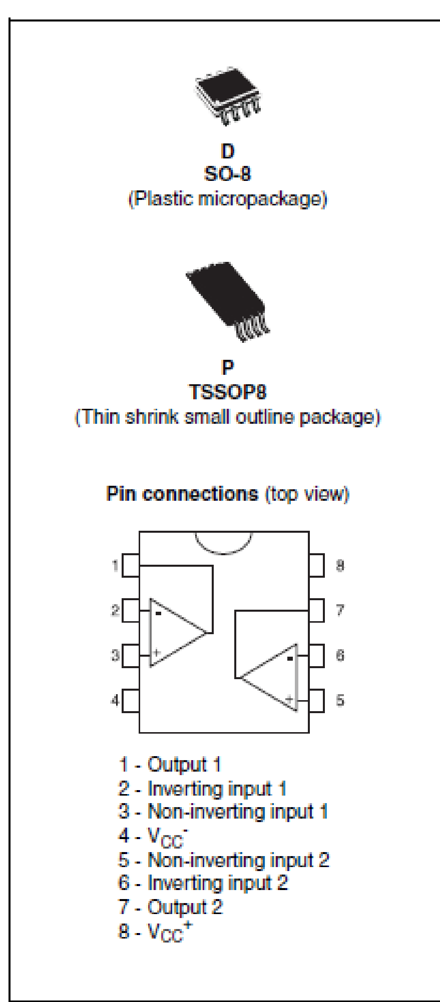
- Wide, single supply voltage range or dual supplies +2 V to +36 V or ±1 V to ±18 V
- Very low supply current (0.4 mA) independent of supply voltage (1 mW/comparator at +5 V)
- Low input bias current: 25 nA typ.
- Low input offset current: ±5 nA typ.
- Input common-mode voltage range includes negative 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.

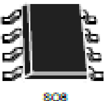


***LM2904WST,***

# LM2904, LM2904A
# LM2904W, LM2904AW

Datasheet

## 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 [($V_{CC}^{+}$) -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.

| Maturity status link | | |
|---|---|---|
| | Enhanced $V_{IO}$ | Enhanced ESD |
| LM2904 | | |
| LM2904A | ✓ | |
| LM2904W | | ✓ |
| LM2904AW | ✓ | ✓ |

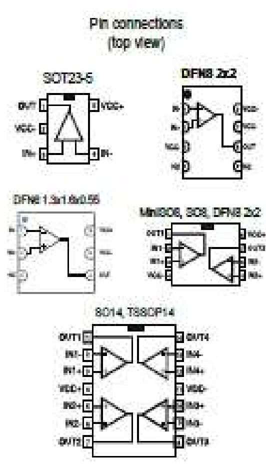
| Related products | |
|---|---|
| TSB572 | Dual op-amps for low-power consumption (380 µA with 2.5 MHz GBP) |
| LM2902<br>LM2902W | Quad op-amps version |
| LM2904WH<br>LM2904AH | High temperature version (150 °C) |

***TSV992IST***

# 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: 820 µA typ.
- High output current: 35 mA
- Operating from 2.5 V to 5.5 V
- Low input bias current, 1 pA 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.

| Product status link |
| --- |
| TSV991, TSV992, TSV994, TSV991A, TSV992A, TSV994A |

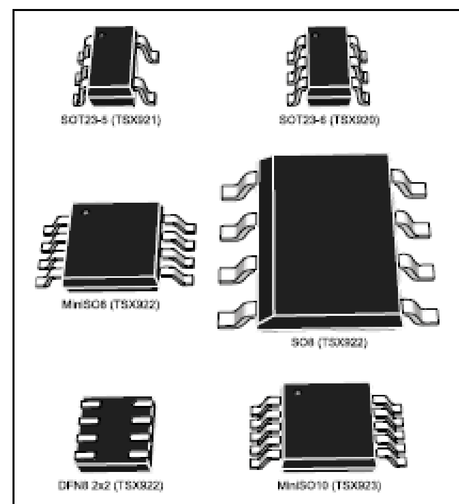
| Related products | |
| --- | --- |
| See TSV911, TSV912, TSV914, TSV911A, TSV912A, TSV914A | For unity-gain stable amplifiers |

***TSX922IST***

# TSX920, TSX921, TSX922, TSX923

## 10 MHz rail-to-rail CMOS 16 V operational amplifiers

Datasheet - production data




### Features

- Rail-to-rail input and output
- Wide supply voltage: 4 V - 16 V
- Gain bandwidth product: 10 MHz typ at 16 V
- Low power consumption: 2.8 mA typ per amplifier at 16 V
- Unity gain stable
- Low input bias current: 10 pA typ
- High tolerance to ESD: 4 kV HBM
- Extended temperature range: -40 °C to 125 °C
- Automotive qualification

### Related products

- See the TSX5 series for low-power features
- See the TSX6 series for micro-power features
- See the TSX929 series for higher speeds
- See the TSV9 series for lower voltages

### Applications

- Communications
- Process control
- Test equipment

### Description

The TSX92x single and dual operational amplifiers (op amps) offer excellent AC characteristics such as 10 MHz gain bandwidth, 17 V/ms slew rate, and 0.0003 % THD+N. These features make the TSX92x family particularly well-adapted for communications, I/V amplifiers for ADCs, and active filtering applications.

Their rail-to-rail input and output capability, while operating on a wide supply voltage range of 4 V to 16 V, allows these devices to be used in a wide range of applications. Automotive qualification is available as these devices can be used in this market segment.

Shutdown mode is available on the single (TSX920) and dual (TSX923) versions enabling an important current consumption reduction while this function is active.

The TSX92x family is available in SMD packages featuring a high level of integration. The DFN8 package, used in the TSX922, with a typical size of 2x2 mm and a maximum height of 0.8 mm offers even greater package size reduction.

**Table 1: Device summary**

| Op-amp version | With shutdown mode | Without shutdown mode |
|---|---|---|
| Single | TSX920 | TSX921 |
| Dual | TSX923 | TSX922 |

**TSV792IST**

# TSV791, TSV792

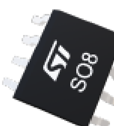
Datasheet

## High bandwidth (50 MHz) low offset (200 µV) rail-to-rail 5 V op-amp

TSV791
SOT23-5

TSV792
DFN8 2x2 mm

TSV792
MiniSO8




TSV792
SO8

| Maturity status link |
| --- |
| TSV791, TSV792 |

| Related products | |
| --- | --- |
| TSZ181<br>TSZ182 | Zero drift amplifiers with more power savings (3 MHz) |
| TSB712 | 36 V high-bandwidth amplifiers (6 MHz) |
| TSB7192 | 36 V high-bandwidth amplifiers (20 MHz) |

## Features

- Gain bandwidth product 50 MHz, unity gain stable
- Slew rate 30 V/µs
- Low input offset voltage 50 µV typ., 200 µV max.
- Low input bias current: 2 pA typ.
- Low input voltage noise density 5 nV/√Hz @ 10 kHz
- Wide supply voltage range: 2.2 V to 5.5 V
- Rail-to-rail input and output
- Extended temperature range: - 40 °C to +125 °C
- Automotive grade version available
- Benefits:
  - Accuracy of measurement virtually unaffected by noise or input bias current
  - Signal conditioning for high frequencies

DRAFT

## Applications

- High bandwidth low-side and high-side current sensing
- Photodiode transimpedance amplification
- A/D converters input buffers
- Power management in solar-powered systems
- Power management in automotive applications

## Description

The TSV791 and TSV792 are single and dual 50 MHz-bandwidth unity-gain-stable amplifiers. The rail-to-rail input stage and the slew rate of 30 V/µs make the TSV791 and TSV792 ideal for low-side current measurement. The excellent accuracy provided by maximum input voltage of 200 µV allows amplifying accurately small-amplitude input signal. The TSV792 can operate from a 2.2 V to 5.5 V single supply it can typically handle an output capacitor up to 1 nF and is fully specified on a load of 22 pF, therefore allowing easy usage as A/D converters input buffer.

## 4.2 Construction note

| | **P/N** *LM2903WST* | **P/N** *LM2904WST* | **P/N** **TSV992IST** | **P/N** **TSX922IST** | **P/N** **TSV792IST** |
|---|---|---|---|---|---|
| **Wafer/Die fab. information** | | | | | |
| Wafer fab manufacturing location | ST Singapore | ST Singapore | ST Singapore | UMC Taiwan | ST Crolles |
| Technology | Bipolar | Bipolar | HF5CMOS | HVG8A | HCMOS7A |
| Die finishing back side | RAW SILICON | RAW SILICON | LAPPED SILICON | LAPPED SILICON | RAW SILICON |
| Die size (microns) | 1120x1050 | 1280x1210 | 1070x1100 | 1700x1400 | 938x1638 |
| Bond pad metallization layers | AlSiCu | AlSiCu | AlCu | AlCu | AlCu |
| Passivation type | Nitride | Nitride | PSG + NITRIDE | PSG + NITRIDE | PSG + NITRIDE + PIX |
| **Wafer Testing (EWS) information** | | | | | |
| Electrical testing manufacturing location | ST Singapore | ST Singapore | ST Singapore | ST Singapore | ST Singapore |
| **Assembly information** | | | | | |
| Assembly site | TSHT | TSHT | TSHT | TSHT | TSHT |
| Package description | MiniSO8 | MiniSO8 | MiniSO8 | MiniSO8 | MiniSO8 |
| Molding compound | Hitachi CEL-9220 | Hitachi CEL-9220 | Hitachi CEL-9220 | Hitachi CEL-9220 | Hitachi CEL-9220 |
| Frame material | Cu | Cu | Cu | Cu | Cu |
| Die attach process | Epoxy Glue | Epoxy Glue | Epoxy Glue | Epoxy Glue | Epoxy Glue |
| Die attach material | Henkel 8200T | Henkel 8200T | Henkel 8200T | Henkel 8200T | Henkel 8200T |
| Wire bonding process | Thermosonic ball bonding | Thermosonic ball bonding | Thermosonic ball bonding | Thermosonic ball bonding | Thermosonic ball bonding |
| Wires bonding materials/diameters | Cu 1 mil Pd Coated | Cu 1 mil Pd Coated | Cu 1 mil Pd Coated | Cu 1 mil Pd Coated | Cu 0.8 mil Pd Coated |
| Lead finishing process | electroplating | electroplating | electroplating | electroplating | electroplating |
| Lead finishing/bump solder material | Matte Sn | Matte Sn | Matte Sn | Matte Sn | Matte Sn |
| **Final testing information** | | | | | |
| Testing location | TSHT | TSHT | TSHT | TSHT | TSHT |

# 5 TESTS PLAN SUMMARY

## 5.1 Test vehicle

| Lot # | Process/ Package | Product Line | Comments |
|---|---|---|---|
| 1 | Bipolar/MiniSO8 | 0193 | GRAL2024018, T3L2017LG0295 and T3L2017LG0296 |
| 2 | Bipolar/MiniSO8 | 0358 | GRAL2024017 and T3L2017LG0304 and T3L2017LG0303 |
| 3 | HF5CMOS/MiniSO8 | V992 | T3L2017LG0317 and T3L2017LG0316 |
| 4 | HVG8A/MiniSO8 | UY32 | T3L2019HC0361and T3L2019HC0362 |
| 5 | HCMOS7A | VB2F | |

## 5.2 Test plan summary

| Test | PC | Std ref. | Conditions | SS | Steps | Failure/SS | | | | | Note |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Lot 1 0193 | Lot 2 0358 | Lot3 V992 | Lot 4 UY32 | Lot 5 VB2F | |
| HTB/ HTOL | N | JESD22 A-108 | Ta = 125°C or 150°C, BIAS | | 168 H | 0/77 | 0/77 | 77 | 77 | 0/77 | Lot 1, 2 at 150°C |
| | | | | | 500 H | 0/77 | 0/77 | 77 | 77 | 0/77 | |
| | | | | | 1000 H | 0/77 | 0/77 | 77 | 77 | 0/77 | |
| | | | | | | | | | | | |
| ELFR | N | JESD22 A-008 | Ta = 150°C or 150°C, BIAS | | 48H | 0/800 | 0/240 | | | | |
| HTSL | N | JESD22 A-103 | Ta = 150°C | | 168 H | 2x0/50 | 3x0/50 | 2x0/50 | 2x0/50 | 0/77 | |
| | | | | | 500 H | 2x0/50 | 3x0/50 | 2x0/50 | 2x0/50 | 0/77 | |
| | | | | | 1000 H | 2x0/50 | 3x0/50 | 2x0/50 | 2x50 | 0/77 | |
| | | | | | 1500H | | 0/50 | | | 0/77 | |
| | | | | | 2000H | | | | | 0/77 | |
| | | | | | | | | | | | |
| PC | | JESD22 A-113 | Drying 24 H @ 125°C<br>Store 168 H @ Ta=85°C Rh=85%<br>Over Reflow @ Tpeak=260°C 3 times | | Final | PASS | PASS | PASS | PASS | PASS | |
| UHAST | Y | JESD22 A-102 | 85%RH / Ta=130°C | | 96 H | 2x0/77 | 3X0/77 | 2X0/77 | 0/77 | 0/77 | |
| TC | Y | JESD22 A-104 | Ta = -55°C to 150°C | | 100 cy | 2x0/77 | 3x0/77 | 2x0/77 | 2x0/77 | 0/77 | |
| | | | | | 200cy | 2x0/77 | 3x0/77 | 2x0/77 | 2x0/77 | 0/77 | |
| | | | | | 500 cy | 2x0/77 | 3x0/77 | 2x0/77 | 2x0/77 | 0/77 | |
| | | | | | 1000cy | 2x0/77 | 3x0/77 | 2x0/77 | 2x77 | 0/77 | |
| | | | | | 2500cy | | 0/77 | | | | |
| THB | Y | JESD22 A-101 | Ta = 85°C, RH = 85%, BIAS | | 168 H | 0/77 | 0/77 | 77 | 77 | 0/77 | |
| | | | | | 500 H | 0/77 | 0/77 | 77 | 77 | 0/77 | |
| | | | | | 1000 H | 0/77 | 0/77 | 77 | 77 | 0/77 | |
| | | | | | 1500H | | 0/77 | | | 0/77 | |

# 6 ANNEXES

## 6.1 Tests Description

| Test name | Description | Purpose |
|---|---|---|
| **Die Oriented** | | |
| **HTOL**<br>High Temperature Operating Life<br><br>**HTB**<br>High Temperature Bias | The device is stressed in static or dynamic configuration, approaching the operative max. absolute ratings in terms of junction temperature and bias condition. | To determine the effects of bias conditions and temperature on solid state devices over time. It simulates the devices' operating condition in an accelerated way.<br>The typical failure modes are related to, silicon degradation, wire-bonds degradation, oxide faults. |
| **HTRB**<br>High Temperature Reverse Bias<br><br>**HTFB / HTGB**<br>High Temperature Forward (Gate) Bias | The device is stressed in static configuration, trying to satisfy as much as possible the following conditions:<br>low power dissipation;<br>max. supply voltage compatible with diffusion process and internal circuitry limitations; | 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. |
| **HTSL**<br>High Temperature Storage Life | The device is stored in unbiased condition at the max. temperature allowed by the package materials, sometimes higher than the max. operative temperature. | To investigate the failure mechanisms activated by high temperature, typically wire-bonds solder joint ageing, data retention faults, metal stress-voiding. |
| **ELFR**<br>Early Life Failure Rate | The device is stressed in biased conditions at the max junction temperature. | To evaluate the defects inducing failure in early life. |
| **Package Oriented** | | |
| **PC**<br>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. |
| **AC**<br>Auto Clave (Pressure Pot) | The device is stored in saturated steam, at fixed and controlled conditions of pressure and temperature. | To investigate corrosion phenomena affecting die or package materials, related to chemical contamination and package hermeticity. |
| **TC**<br>Temperature Cycling | The device is submitted to cycled temperature excursions, between a hot and a cold chamber in air atmosphere. | To investigate failure modes related to the thermo-mechanical stress induced by the different thermal expansion of the materials interacting in the die-package system. Typical failure modes are linked to metal displacement, dielectric cracking, molding compound delamination, wire-bonds failure, die-attach layer degradation. |

| Test name | Description | Purpose |
|---|---|---|
| **TF / IOL**<br>Thermal Fatigue / Intermittent Operating Life | The device is submitted to cycled temperature excursions generated by power cycles (ON/OFF) at T ambient. | To investigate failure modes related to the thermo-mechanical stress induced by the different thermal expansion of the materials interacting in the die-package system. Typical failure modes are linked to metal displacement, dielectric cracking, molding compound delamination, wire-bonds failure, die-attach layer degradation. |
| **THB**<br>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. |
| **Other** | | |
| **ESD**<br>Electro Static Discharge | The device is submitted to a high voltage peak on all his pins simulating ESD stress according to different simulation models.<br>CBM: Charged Device Model<br>HBM: Human Body Model<br>MM: Machine Model | To classify the device according to his susceptibility to damage or degradation by exposure to electrostatic discharge. |
| **LU**<br>Latch-Up | The device is submitted to a direct current forced/sunk into the input/output pins. Removing the direct current no change in the supply current must be observed. | To verify the presence of bulk parasitic effect inducing latch-up. |