# PRODUCT/PROCESS CHANGE NOTIFICATION

PCN APM-SLI/09/4555
Notification Date 05/07/2009

**MATERIAL SET CHANGE (Halogen Free) for TSSOP14 & TSSOP16 packages in ST Bouskoura (Morocco)**

**Table 1. Change Implementation Schedule**

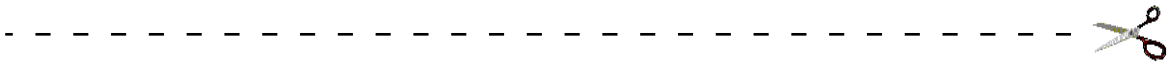
| | |
|---|---|
| Forecasted implementation date for change | 24-Jul-2009 |
| Forecasted availabillity date of samples for customer | 15-May-2009 |
| Forecasted date for **STMicroelectronics** change Qualification Plan results availability | 30-Apr-2009 |
| Estimated date of changed product first shipment | 06-Aug-2009 |

**Table 2. Change Identification**

| | |
|---|---|
| Product Identification (Product Family/Commercial Product) | "Standard" products in TSSOP14 & TSSOP16 |
| Type of change | Multiple types of changes |
| Reason for change | Halogen Free program + reliability improvement |
| Description of the change | Halogen Free molding compound on TSSOP14 & TSSOP16 packages. Pad size reduction from 3x3.8mm to 2.16x2.16mm for small dice. Wires from 1 to 0.8mils for production rationalization. Samples of LM324PT are available right now for customer qualification. Available on May 15th, 2009 for any other parts. |
| Product Line(s) and/or Part Number(s) | See attached |
| Description of the Qualification Plan | See attached |
| Change Product Identification | Internal sales types will end with H letter |
| Manufacturing Location(s) | 1]St Bouskoura 2 - Morocco |

**Table 3. List of Attachments**

| | |
|---|---|
| Customer Part numbers list | |
| Qualification Plan results | |



| Customer Acknowledgement of Receipt | **PCN APM-SLI/09/4555** |
|---|---|
| Please sign and return to STMicroelectronics Sales Office | **Notification Date 05/07/2009** |

| | |
|---|---|
| ☐ Qualification Plan Denied | Name: |
| ☐ Qualification Plan Approved | Title: |
| | Company: |
| ☐ Change Denied | Date: |
| ☐ Change Approved | Signature: |

Remark

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# DOCUMENT APPROVAL

| Name | Function |
|---|---|
| Gilot, Yves | Division Marketing Manager |
| Kaire, Jean-Claude | Division Product Manager |
| Paccard, Francoise | Division Q.A. Manager |

# Reliability Report

*New material set (Halogen free) on TSSOP 14*
*in ST Bouskoura*
*PCN APM-SLI/09/4555*

| General Information | |
|---|---|
| **Product Line** | *0324 / 0339* |
| **Product Description** | *OP amp / comparator* |
| **P/N** | *LM324WPT / LM339PT* |
| **Product Group** | *APM* |
| **Product division** | *Standard Ic's* |
| **Package** | *TSSOP14* |
| **Silicon Process technology** | *Bipolar* |

| Locations | |
|---|---|
| **Wafer fab** | *Ang Mo Kio* |
| **Assembly plant** | *ST Bouskoura* |
| **Reliability Lab** | *ST Grenoble / ST Bouskoura* |

## DOCUMENT INFORMATION

| Version | Date | Pages | Prepared by | Approved by | Comment |
|---|---|---|---|---|---|
| 1.0 | 14-Apr-2009 | 10 | JM Bugnard | F. Paccard | First issue |
| | | | | | |
| | | | | | |

STMicroelectronics.

## TABLE OF CONTENTS

# 1 APPLICABLE AND REFERENCE DOCUMENTS

| Document reference | Short description |
|---|---|
| **AEC-Q100** | Stress test qualification for automotive grade integrated circuits |
| **AEC-Q101** | Stress test qualification for automotive grade discrete semiconductors |
| **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 halogen free Bill of Material for TSSOP14 produced in ST Bouskoura.

## 3.2 Conclusion

Qualification Plan requirements have been fulfilled without exception. It is stressed that reliability tests have shown that the devices behave correctly against environmental tests (no failure). Moreover, the stability of electrical parameters during the accelerated tests demonstrates the ruggedness of the products and safe operation, which is consequently expected during their lifetime.

# 4 DEVICE CHARACTERISTICS

## 4.1 Device description

**LM124/224/324 family**: These circuits consist of four independent, high gain, internally frequency compensated operational amplifiers. They operate from a single power supply over a wide range of voltages.
Operation from split power supplies is also possible and the low power supply current drain is independent of the magnitude of the power supply voltage.

**LM139/239/339 family**: This family of devices consists of four independent precision-voltage comparators with an offset voltage specification as low as 2 mV maximum for LM339A, LM239A and LM139A.
Each comparator has been designed specifically to operate from a single power supply over a wide range of voltages. Operation from split power supplies is also possible.
These comparators also have a unique characteristic in that the input common mode voltage range includes ground even though operated from a single power supply voltage.

## 4.2 Construction note

| | Current material set | New material set | |
|---|---|---|---|
| **Wafer/Die fab. information** | | **P/N: LM324PT** | **P/N LM339PT** |
| Wafer fab manufacturing location | No change | Ang Mo Kio | Ang Mo Kio |
| Technology | No change | Bipolar | Bipolar |
| Die finishing back side | No change | Raw silicon | Raw silicon |
| Die size | No change | 1.68x1.57mm | 1.1x1.09mm |
| Bond pad metallization layers | No change | AlSiCu | AlSiCu |
| Passivation type | No change | Silicon Nitride | Silicon Nitride |
| **Wafer Testing (EWS) information** | | | |
| Electrical testing manufacturing location | No change | Ang Mo Kio | Ang Mo Kio |
| Tester | No change | Credence ASL1k | Credence ASL1k |
| **Assembly information** | | | |
| Assembly site | No change | ST Bouskoura | ST Bouskoura |
| Package description | No change | TSSOP14 | TSSOP14 |
| Molding compound | **Shinetsu KMC184-3** | **Sumitomo G605L** | **Sumitomo G605L** |
| Frame material | **Copper C7025** | **Copper C194** | **Copper C194** |
| Die pad size | **118 x 150** | **85x85 mils** | **85x85 mils** |
| Die attach process | No change | Epoxy glue | Epoxy glue |
| Die attach material | No change | Ablebond 8390 | Ablebond 8390 |
| Wire bonding process | No change | Thermosonic ball bonding | Thermosonic ball bonding |
| Wires bonding materials/diameters | **Gold 1 mil** | **Gold / 0.8mils** | **Gold / 0.8mils** |
| Lead finishing process | No change | Preplated NiPdAu | Preplated NiPdAu |
| Lead finishing/bump solder material | No change | NiPdAu | NiPdAu |
| **Final testing information** | | | |
| Testing location | No change | ST Bouskoura | ST Bouskoura |
| Tester | No change | Credence ASL1k | Credence ASL1k |

# 5 TESTS RESULTS SUMMARY

## 5.1 Test vehicle

| Lot # | Diffusion Lot | Assy Lot | Trace Code | Process/ Package | Product Line | Comments |
|---|---|---|---|---|---|---|
| 1 | V6827N9N | CZ8300BEZ3-8 | 830 | Bipolar / TSSOP14 | 0324 | Reliability lab ST Grenoble |
| 2 | V6827V65 | CZ8300KWZU | 830 | Bipolar / TSSOP14 | 0339 | Reliability lab ST Grenoble |
| 3 | V6827V65 | CZ8300KWZU | 830 | Bipolar / TSSOP14 | 0339 | Reliability lab ST Bouskoura |

Detailed results in below chapter will refer to P/N and Lot #.

## 5.2 Test plan and results summary

| Test | PC | Std ref. | Conditions | SS | Steps | Failure/SS | | | Note |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Lot 1 0324 | Lot 2 0339 | Lot 3 0339 | |
| **Die Oriented Tests** | | | | | | | | | |
| HTB | N | JESD22 A-108 | Tj = 125℃, BIAS | 156 | 1000 H | 0/78 | 0/78 | | |
| HTSL | N | JESD22 A-103 | Ta = 150℃ | 45 | 1000 H | | | 0/77 | |
| **Package Oriented Tests** | | | | | | | | | |
| PC | | JESD22 A-113 | Drying 24 H @ 125℃<br>Store 168 H @ Ta=85℃ Rh=85%<br>Over Reflow @ Tpeak=260℃ 3 times | 44 | Final | 0/22 | 0/22 | | No delamination at die/resin interface |
| AC | Y | JESD22 A-102 | Pa=2Atm / Ta=121℃ | 233 | 168 H | 0/78 | 0/78 | 0/77 | |
| TC | Y | JESD22 A-104 | Ta = -65℃ to 150℃ | 233 | 1000 cy | 0/78 | 0/78 | 0/77 | |
| THB | Y | JESD22 A-101 | Ta = 85℃, RH = 85%, BIAS | 156 | 1000 H | 0/78 | 0/78 | | |
| **Other Tests** | | | | | | | | | |
| ESD | N | AEC Q100 | CDM | 3 | 750V | 0/3 | | | |

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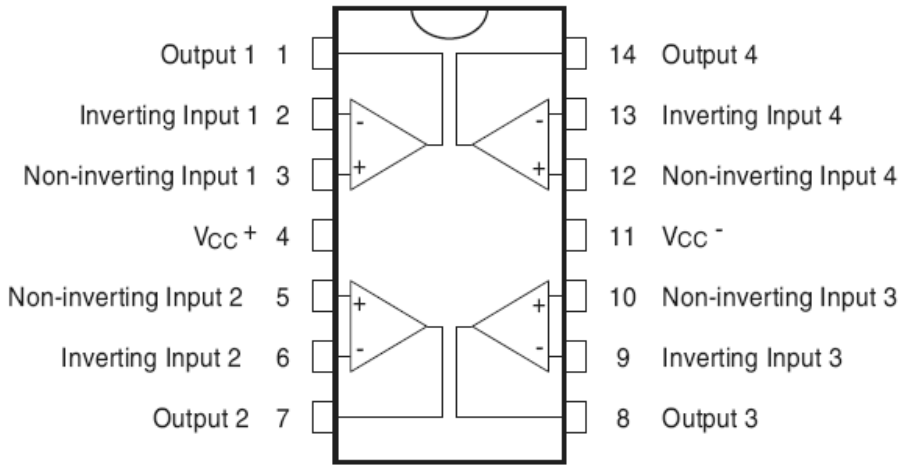
# 6 ANNEXES

## 6.1 Device details

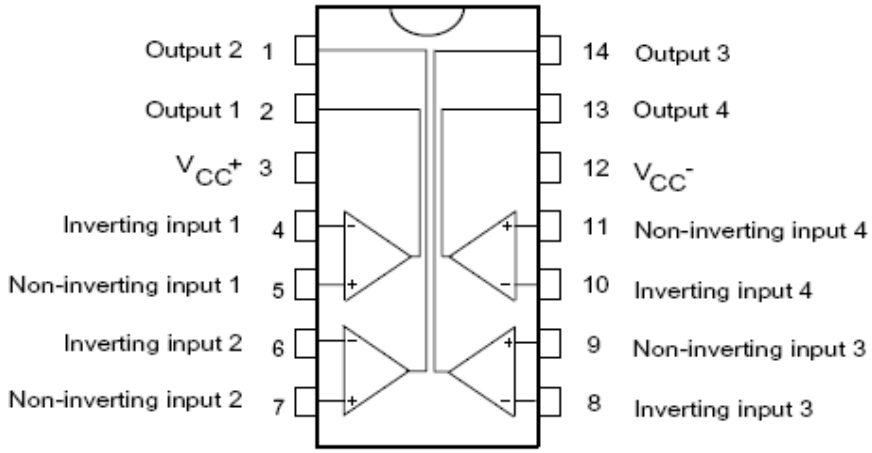
### 6.1.1 Pin connection

**LM324WPT**



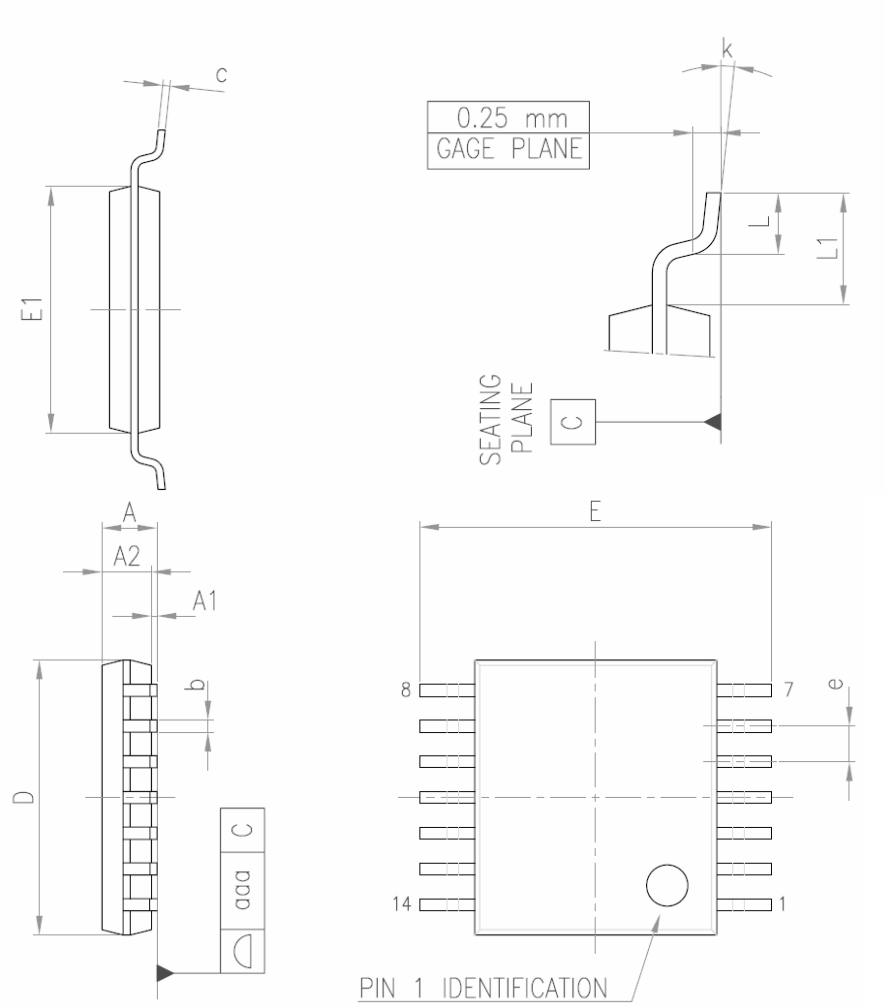

**LM339PT**

Pin connections (top view)



## 6.2 Test Description

### 6.2.1 Package outline/Mechanical data




Measurements:

**Refer to spec**: 0080337 Sample size: 5pcs

| Parameters | Criteria Score 0 | Criteria Score 1 | Criteria Score 2 | This Report | Dimensions | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Unit.1 | Unit.2 | Unit.3 | Unit.4 | Unit.5 |
| **A** | > 1.20 mm | Not applicable | < 1.20 mm | 2 | 1.002 | 1.025 | 1.011 | 1.006 | 0.997 |
| **A1** | Outside 0.05 ~ 0.15 mm | Not applicable | Within 0.05 ~ 0.15 mm | 2 | 0.068 | 0.086 | 0.075 | 0.075 | 0.061 |
| **A2** | Outside 0.80 ~ 1.05 mm | Not applicable | Within 0.80 ~ 1.05 mm | 2 | 0.940 | 0.944 | 0.941 | 0.932 | 0.938 |
| **b** | Outside 0.19 ~ 0.30 mm | Not applicable | Within 0.19 ~ 0.30 mm | 2 | 0.224 | 0.219 | 0.223 | 0.222 | 0.224 |
| **c** | Outside 0.09 ~ 0.20 mm | Not applicable | Within 0.09 ~ 0.20 mm | 2 | 0.109 | 0.112 | 0.132 | 0.128 | 0.110 |
| **D** | Outside 4.90 ~ 5.10 mm | Not applicable | Within 4.90 ~ 5.10 mm | 2 | 4.978 | 4.986 | 4.992 | 4.980 | 4.976 |
| **E** | Outside 6.20 ~ 6.60 mm | Not applicable | Within 6.20 ~ 6.60 mm | 2 | 6.409 | 6.407 | 6.400 | 6.407 | 6.405 |
| **E1** | Outside 4.30 ~ 4.50mm | Not applicable | Within 4.30 ~ 4.50mm | 2 | 4.369 | 4.373 | 4.372 | 4.359 | 4.368 |
| **e** | Not applicable | Not applicable | TYP.= 0.65 mm | 2 | 0.650 | 0.650 | 0.649 | 0.647 | 0.655 |
| **L** | Outside 0.45 ~ 0.75 mm | Not applicable | Within 0.45 ~ 0.75 mm | 2 | 0.568 | 0.557 | 0.550 | 0.561 | 0.543 |
| **L1** | Not applicable | Not applicable | TYP. = 1.00 mm | 2 | 1.043 | 1.070 | 1.075 | 1.078 | 0.998 |
| **k** | Outside 0 ~ 8 | Not applicable | Within 0 ~ 8 | 2 | 5.0 | 6.2 | 5.6 | 6.5 | 6.3 |
| **aaa** | Not applicable | Not applicable | < 0.10 mm | 2 | 0.022 | 0.015 | 0.024 | 0.058 | 0.025 |

Results conform to ST specification

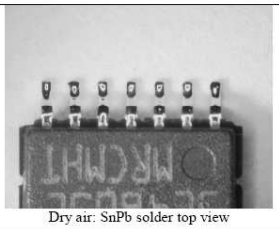
### 6.2.2 Solderability

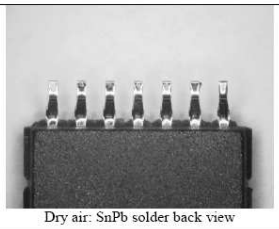
**Refer to spec:** 00128685 Samples size: 40 unit

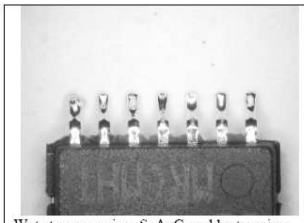
| Parameters | Criteria Score 0 | Criteria Score 1 | Criteria Score 2 | Control Plan | This Report | Comments |
|---|---|---|---|---|---|---|
| **Dry air: 150°C, 8hours SnAgCu solder at 245°C; 10"** | <95% coverage | N/A | >95% coverage and no visible defects | CL | 2 | |
| **Dry air: 150°C, 8hours SnPb solder at 220 °C; 10"** | <95% coverage | N/A | >95% coverage and no visible defects | CL | 2 | |
| **Wet storage ageing: 85 °C/85%HR,8hours SnAgCu solder at 245 °C; 10"** | <95% coverage | N/A | >95% coverage and no visible defects | CL | 2 | |
| **Wet storage ageing: 85 °C/85%HR,8hours SnPb solder at 220 °C; 10"** | <95% coverage | N/A | >95% coverage and no visible defects | CL | 2 | |

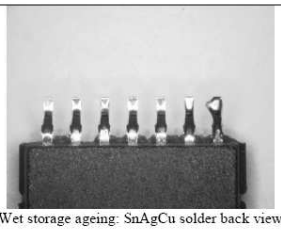

Dry air: SnAgCu solder top view

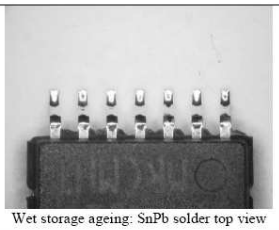

Dry air: SnAgCu solder back view

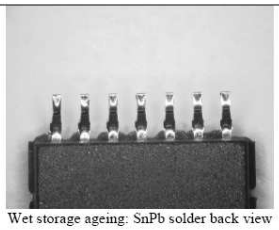

Dry air: SnPb solder top view


Dry air: SnPb solder back view


Wet storage ageing: SnAgCu solder top view


Wet storage ageing: SnAgCu solder back view


Wet storage ageing: SnPb solder top view


Wet storage ageing: SnPb solder back view

Results conform to ST specification

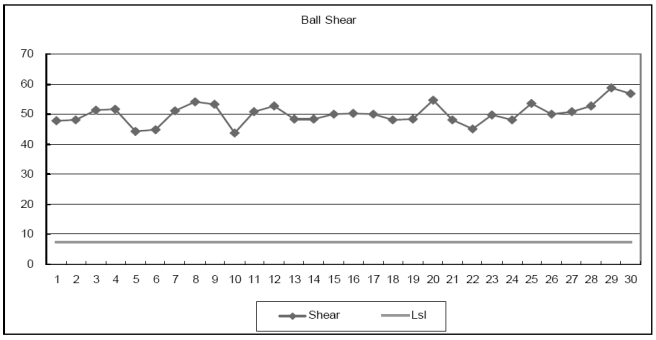
### 6.2.3 Ball shear test

**Refer to spec:** 0018726 Sample size: 30 bonds

| No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Ball shear value (g)** | 47.84 | 48.08 | 51.47 | 51.73 | 44.32 | 44.95 | 51.11 | 54.23 | 53.24 | 43.87 | 50.76 | 52.72 | 48.43 | 48.39 | 50.07 |
| **No.** | **16** | **17** | **18** | **19** | **20** | **21** | **22** | **23** | **24** | **25** | **26** | **27** | **28** | **29** | **30** |
| **Ball shear value (g)** | 50.32 | 50.05 | 48.07 | 48.34 | 54.80 | 48.19 | 45.15 | 49.82 | 48.07 | 53.65 | 50.05 | 50.86 | 52.79 | 58.78 | 56.78 |
| **CPK** | 4.071 | | | | | | | | | | | | | | |
| **Failure mode** | Ball shear | | | | | | | | | | | | | | |

**Result:**

| Parameters | Criteria Score 0 | Criteria Score 1 | Criteria Score 2 | This Report | Comments |
|---|---|---|---|---|---|
| **Ball Shear Test (wire Au D 0.8)** | Ball shear strength<7.5g; Or failure mode: Ball lift; Cratering; wire shear. | Within spec. but can be improved toward ideal value, target or 1.33 ≤ CPK<1.67 | Ball shear strength>15g; and proper mode: Aluminum shear; ball shear; bond pad lift. | 2 | |




**LSL=7.5g**

Results conform to ST specification

## Tests Description

| Test name | Description | Purpose |
|---|---|---|
| **ESD** Electro Static Discharge | 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 | To classify the device according to his susceptibility to damage or degradation by exposure to electrostatic discharge. |
| **HTB** 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. The typical failure modes are related to, silicon degradation, wire-bonds degradation, oxide faults. |
| **HTSL** 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. |
| **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. 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 "pop corn" effect and delamination. |
| **AC** 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** Temperature Cycling | The device is submitted to cycled temperature excursions, between a hot and a cold chamber in air atmosphere. | To investigate failure modes related to the thermo-mechanical stress induced by the different thermal expansion of the materials interacting in the die-package system. Typical failure modes are linked to metal displacement, dielectric cracking, molding compound delamination, wire-bonds failure, die-attach layer degradation. |
| **THB** 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. |

## 6.3 Drift Analysis (during HTB test)

### LM324WPT lot #1

| Test Name | unit | 0/1000h drift in mV min | max | avg |
|---|---|---|---|---|
| **P101_A0** | mV | -0.287 | 0.092 | 0.080 |
| **P101_B0** | mV | -0.302 | 0.031 | 0.085 |
| **P101_C0** | mV | -0.220 | 0.147 | 0.057 |
| **P101_D0** | mV | -0.214 | 0.055 | 0.077 |

### LM339PT lot #2

| Test Name | unit | 0/1000h drift in mV min | max | avg |
|---|---|---|---|---|
| **P101_A0** | mV | -0.379 | 0.227 | 0.105 |
| **P101_B0** | mV | -0.303 | 0.303 | 0.115 |
| **P101_C0** | mV | -0.227 | 0.379 | 0.163 |
| **P101_D0** | mV | -0.227 | 0.454 | 0.149 |

Results are conform to ST requirements (+/- 0.5mV)

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