# PRODUCT / PROCESS CHANGE NOTIFICATION

| 1. PCN basic data | |
|---|---|
| 1.1 Company | STMicroelectronics International N.V |
| 1.2 PCN No. | AMS/21/12963 |
| 1.3 Title of PCN | Introduction of ST Bouskoura for selected Standard products assembled in SO8 (Signal conditioning products) |
| 1.4 Product Category | See product list |
| 1.5 Issue date | 2021-08-03 |

| 2. PCN Team | |
|---|---|
| 2.1 Contact supplier | |
| 2.1.1 Name | ROBERTSON HEATHER |
| 2.1.2 Phone | +1 8475853058 |
| 2.1.3 Email | heather.robertson@st.com |
| 2.2 Change responsibility | |
| 2.2.1 Product Manager | Marcello SAN BIAGIO |
| 2.1.2 Marketing Manager | Salvatore DI VINCENZO |
| 2.1.3 Quality Manager | Jean-Marc BUGNARD |

| 3. Change | | |
|---|---|---|
| 3.1 Category | 3.2 Type of change | 3.3 Manufacturing Location |
| 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) | ST Bouskoura |

| 4. Description of change | | |
|---|---|---|
| | Old | New |
| 4.1 Description | Assembly plant :<br>- Subcontractor Amkor | Assembly plant :<br>- Subcontractor Amkor<br>- ST Bouskoura |
| 4.2 Anticipated Impact on form,fit, function, quality, reliability or processability? | No impact | |

| 5. Reason / motivation for change | |
|---|---|
| 5.1 Motivation | Progressing on the activities related to quality continuous improvement and production rationalization, ST is glad to announce the assembly of selected products in SO8 package in ST Bouskoura. |
| 5.2 Customer Benefit | SERVICE IMPROVEMENT |

| 6. Marking of parts / traceability of change | |
|---|---|
| 6.1 Description | New Finished good codes |

| 7. Timing / schedule | |
|---|---|
| 7.1 Date of qualification results | 2021-08-02 |
| 7.2 Intended start of delivery | 2021-11-15 |
| 7.3 Qualification sample available? | Upon Request |

| 8. Qualification / Validation | | | |
|---|---|---|---|
| 8.1 Description | 12963 RER__Qual report SO Amkor to Bouskoura_1-.pdf | | |
| 8.2 Qualification report and qualification results | Available (see attachment) | Issue Date | 2021-08-03 |

| 9. Attachments (additional documentations) |
|---|
| 12963 Public product.pdf<br>12963 RER__Qual report SO Amkor to Bouskoura_1-.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 |
| | LMC6482IDT | |
| | TSB572IDT | |
| | TSB712AIDT | |
| | TSB712IDT | |
| | TSB7192AIDT | |
| | TSB7192IDT | |
| | TSX712IDT | |
| | TSX7192IDT | |
| | TSZ182IDT | |

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***PCN Title :*** Introduction of ST Bouskoura for selected Standard products assembled in SO8 (Signal conditioning products)

***PCN Reference :*** AMS/21/12963

***Subject :*** Public Products List

Dear Customer,

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

| | | |
|---|---|---|
| TSB712AIDT | TSX712IDT | TSZ182IDT |
| TSB7192AIDT | TSB712IDT | TSB572IDT |
| TSB7192IDT | TSX7192IDT | LMC6482IDT |

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**PRODUCT/PROCESS**
CHANGE NOTIFICATION

PCN AMS/21/12963

# Analog, MEMS & Sensors Group (AMS)

## Introduction of ST Bouskoura for selected products assembled in SO8 (Signal conditioning products)

## WHAT:

Progressing on the activities related to quality continuous improvement and production rationalization, ST is glad to announce the assembly of selected products in SO8 package in ST Bouskoura.

| Material | Current process | Modified process | Comment |
|---|---|---|---|
| Diffusion location | ST Singapore, ST Crolles, ST Agrate | ST Singapore, ST Crolles, ST Agrate | No change |
| Assembly location | Amkor Philippines | ST Bouskoura | |
| Molding compound | Sumitomo G600<br>Sumitomo G700LS | Sumitomo G700KC | Alignment on high reliability compound |
| Die attach | Ablestick 8290 | Ablestick 8601-S25 | |
| Lead-frame | Copper C194 | Copper C194 | |
| Wire | Gold 1mil and 0.8mil | Copper 1 mil / Gold 1 Mil | Gold 1 mil for HCMOS7 technology |
| Plating | Sn and NiPdAu | Sn | |
| MSL | 1 | 1 | |

## WHY:

This change will contribute to ST's continuous service and quality improvement and ensure a consistent assembly process through all the SO production lines.

## 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:

This 2nd source will be activated in Q4-2021 in ST Bouskoura.

## 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 also no change in the packing process or in the standard delivery quantities.

Shipments may start earlier with the customer's written agreement.

# Reliability Report

*Product transfer SO8 (HCMOS7, BiC-MOS40 and HVG8A technologies) from Amkor to ST Bouskoura*

| General Information | |
|---|---|
| **Product Line :** | *A256, VB2F, VB2S* |
| **Product Description** | Dual op amps |
| **P/N** | TSB612IYDT, TSV792IYDT, TSV7722IYDT |
| **Product Group** | *AMS* |
| **Product division** | *GPA* |
| **Package** | *SO8* |
| **Silicon Process technology** | *HCMOS7, BiCMOS40,* |

| Locations | |
|---|---|
| **Wafer fab** | *ST Crolles*<br>*ST Singapore* |
| **Assembly plant** | *ST Bouskoura (Morocco)* |
| **Reliability Lab** | *ST Grenoble France*<br>*ST Bouskoura Morocco* |

# 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 the second source of signal conditional products in HCMOS7, BiCMOS40 and HVG8A from Amkor to ST Bouskoura for standard and Automotive Grade.

## 3.2 Conclusion

Qualification Plan requirements have been 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

***TSB612IYDT***

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**TSB611, TSB612**

Datasheet

Low-power, rail-to-rail output, 36 V operational amplifiers

SO8

MiniSO8

SOT23-5

### Features

- Low offset voltage: 1 mV max
- Low current consumption: 125 µA max. per amplifier at 36 V
- Wide supply voltage: 2.7 to 36 V
- Gain bandwidth product: 560 kHz typ
- Unity gain stable
- Rail-to-rail output
- Input common mode voltage includes ground
- High tolerance to ESD: 4 kV HBM
- Extended temperature range: -40 °C to 125 °C
- Automotive qualification

### Applications

- Industrial
- Power supplies
- Automotive

### Description

The TSB611, TSB612 operational amplifiers (op amps) offer an extended supply voltage operating range and rail-to-rail output. They also offer an excellent speed/power consumption ratio with 560 kHz gain bandwidth product while consuming less than 125 µA per amplifier at 36 V supply voltage.

The TSB611, TSB612 operate over a wide temperature range from -40 °C to 125°C making this device ideal for industrial and automotive applications.

Thanks to their small package size, the TSB611, TSB612 can be used in applications where space on the board is limited. They can thus reduce the overall cost of the PCB.

| Maturity status link |
| --- |
| TSB611, TSB612 |

***TSV792IYDT***

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# 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

### 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 6.5 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

### 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

| 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) |

### 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 TSV79x 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.

***TSV7722IYDT***

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# TSV7721, TSV7722, TSV7723

Datasheet

## High bandwidth (22 MHz) low offset (200 µV) 5 V op amp


### Features

- Gain bandwidth product 22 MHz, unity gain stable
- High accuracy input offset voltage: 50 µV typ., 200 µV max.
- Low input bias current: 2 pA typ.
- Low input voltage noise density: 7 nV/√Hz
- Wide supply voltage range: 1.8 V to 5.5 V
- Output rail-to-rail
- Input common-mode range includes low rail
- Automotive grade and shutdown versions available
- Benefits:
  - High frequency signal conditioning
  - Optimized accuracy for low-side current sensing

### Applications

- Low-side current measurement
- Photodiode amplifiers
- Automotive current measurement and sensor signal conditioning
- Strain gauges signal conditioning

### Description

The TSV7721, TSV7722 and TSV7723 are single and dual 22 MHz-bandwidth unity-gain-stable amplifiers. The input offset voltage of 200 µV max. (50 µV typ.) at room temperature, optimized for common-mode close to ground makes the TSV772x ideal for low-side current measurements.

The TSV772x can operate from 1.8 V to 5.5 V single supply and it is fully specified on a load of 47 pF, therefore allowing easy usage as A/D converters input buffer.

The TSV772x series offers rail-to-rail output, excellent speed/power consumption ratio, and 22 MHz gain bandwidth product, while consuming just 1.7 mA at 5 V.

The devices also feature an ultra-low input bias current that enables connection to photodiodes and other sensors where current is the key value to be measured.

These features make the TSV772x series ideal for high-accuracy, high-bandwidth sensor interfaces.

| Maturity status link | Channel | Automotive | Package |
|---|---|---|---|
| TSV7721 | 1 | | SOT23-5 |
| | 1 | • | SOT23-5 |
| TSV7722 | 2 | | DFN8 |
| | 2 | | MiniSO8 |
| | 2 | | SO8 |
| | 2 | • | MiniSO8 |
| | 2 | • | SO8 |
| TSV7723 | 2 | | MiniSO10 |

| Related products | |
|---|---|
| TSV792 | Rail-to-rail amplifier with higher GBW 50 MHz |
| TSB7192 | 22 MHz amplifier with 36 V supply voltage |

## 4.2 Construction note

| | P/N TSB612IYDT | P/N TSV792IYDT | P/N TSV7722 |
|---|---|---|---|
| **Wafer/Die fab. information** | | | |
| Wafer fab manufacturing location | ST Singapore | ST Crolles | ST Crolles |
| Technology | BiCMOS40 | HCMOS7 | HCMOS7 |
| Die finishing back side | RAW SILICON | RAW SILICON | RAW SILICON |
| Die size (microns) | 1518x1656 | 938x1638 | 888x1588 |
| Bond pad metallization layers | AlSiCu | AlCu | AlCu |
| Passivation type | PSG + NITRIDE | PSG + NITRIDE + PIX | PSG + NITRIDE + PIX |
| **Wafer Testing (EWS) information** | | | |
| Electrical testing manufacturing location | ST Singapore | | |
| **Assembly information** | | | |
| Assembly site | ST Bouskoura | | |
| Package description | SO8 | | |
| Molding compound | EME G700KC | | |
| Frame material | Copper | | |
| Die attach process | Epoxy Glue | | |
| Die attach material | 8601S-25 | | |
| Wire bonding process | Thermosonic ball bonding | | |
| Wires bonding materials/diameters | Cu 1 mil | Gold 1 Mil | |
| Lead finishing process | electroplating | | |
| Lead finishing/bump solder material | Matte tin | | |
| **Final testing information** | | | |
| Testing location | ST Bouskoura | | |

# 5 TESTS RESULTS SUMMARY

## 5.1 Test vehicle

| Lot # | Process/ Package | Product Line | Comments |
|---|---|---|---|
| 1 | BiCMOS40/SO8 | A256 | |
| 2 | HCMOS7/SO8 | VB2F | |
| 3 | HVG8A/SO8 | VB2S | |

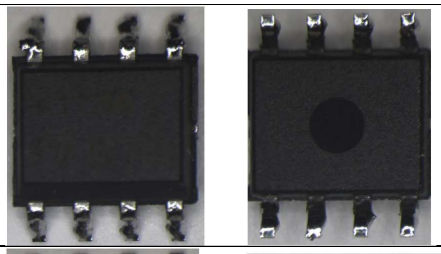
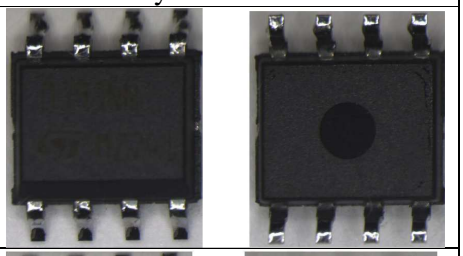
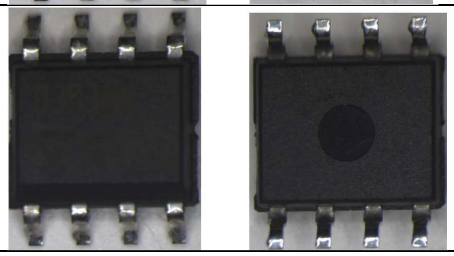
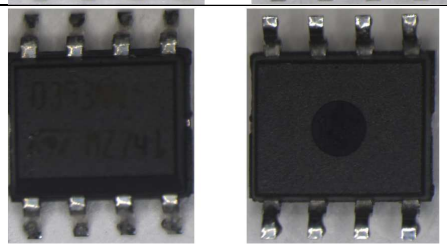
## 5.2 Test plan and results summary

| Test | PC | Std ref. | Conditions | SS | Steps | Failure/SS | | | | | | Note |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | TSB612 | TSV792 | TSX922 | | | | |
| HTOL | N | JESD22 A-108 | Tj = 150°C, BIAS | | 168 H | 2x0/77 | 2x0/77 | 0/77 | | | | |
| | | | | | 500 H | 2x0/77 | 2x0/77 | 0/77 | | | | |
| | | | | | 1000 H | 2x0/77 | 2x0/77 | 0/77 | | | | |
| | | | | | 2000h | 2x0/77 | 0/77 | 0/77 | | | | |
| ELFR | N | JESD22 A-008 | Ta = 125°C, BIAS | | 48h | 2x0/800 | 0/800 | 0/800 | | | | |
| HTSL | N | JESD22 A-103 | Ta = 150°C | | 168 H | 2x0/77 | 2x0/77 | 0/77 | | | | |
| | | | | | 500 H | 2x0/77 | 2x0/77 | 0/77 | | | | |
| | | | | | 1000 H | 2x0/77 | 2x0/77 | 0/77 | | | | |
| | | | | | 2000H | 2x0/77 | 0/77 | 0/77 | | | | |
| Package Oriented Tests | | | | | | | | | | | | |
| PC | | JESD22 A-113 | Drying 24 H @ 125°C Store 168 H @ Ta=85°C Rh=85% Over Reflow @ Tpeak=260°C 3 times | | Final | PASS | PASS | PASS | | | | |
| AC | Y | JESD22 A-102 | Pa=2Atm / Ta=121°C | | 96 H | 2x0/77 | 2x0/77 | 0/77 | | | | |
| TC | Y | JESD22 A-104 | Ta = -65°C to 150°C | | 100 cy | 2x0/77 | 2x0/77 | 0/77 | | | | |
| | | | | | 200 cy | 2x0/77 | 2x0/77 | 0/77 | | | | |
| | | | | | 500 cy | 2x0/77 | 2x0/77 | 0/77 | | | | |
| | | | | | 1000cy | 2x0/77 | 2x0/77 | 0/77 | | | | |
| | | | | | 2000cy | 2x0/77 | 2x0/77 | 0/77 | | | | |
| THB | Y | JESD22 A-101 | Ta = 85°C, RH = 85%, BIAS | | 168 H | 0/77 | 0/77 | 0/77 | | | | |
| | | | | | 500 H | 0/77 | 0/77 | 0/77 | | | | |
| | | | | | 1000 H | 0/77 | 0/77 | 0/77 | | | | |
| | | | | | 1500H | 0/77 | 0/77 | 0/77 | | | | |
| | | | | | 2000H | 0/77 | 0/77 | 0/77 | | | | |

# Solderability:

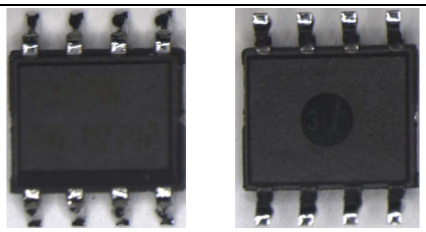
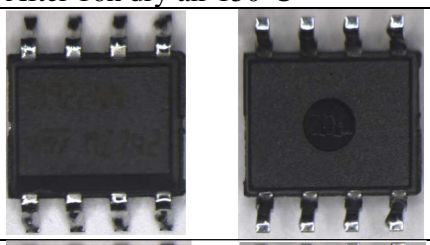
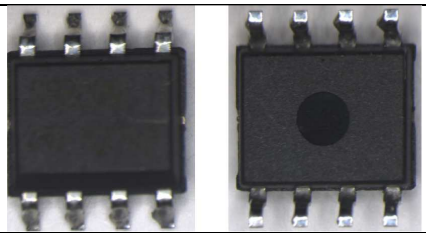
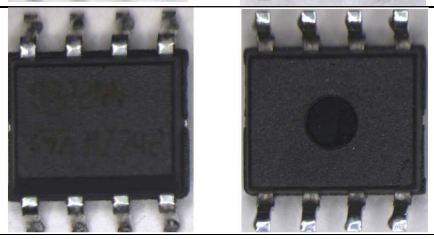
**Test vehicle 0393**

Lot ref: CZ7410EHQZ

| | After 8h at 85°C/85%RH | After 16h dry air 150°C |
|---|---|---|
| SnPb bath |  |  |
| SnAgCu bath |  |  |
| Conclusion | 5 units/ split passed the test with no issue reported | |

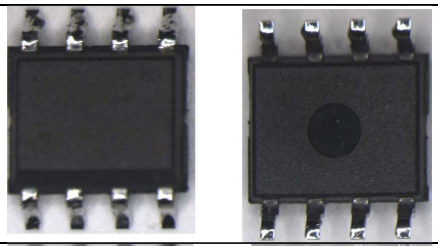
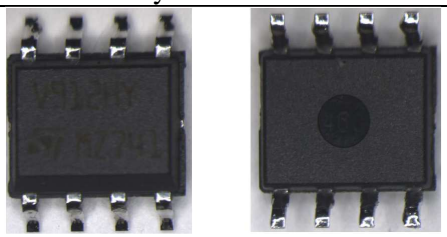
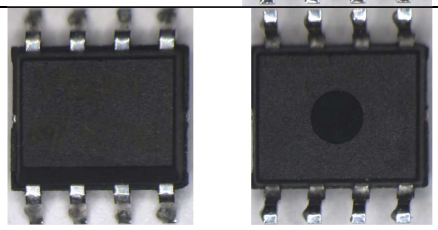
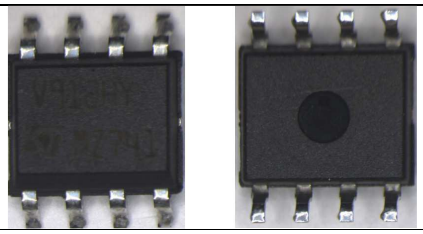
**Test vehicle 0922**

Lot ref: CZ7420D2RM

| | After 8h at 85°C/85%RH | After 16h dry air 150°C |
|---|---|---|
| SnPb bath |  |  |
| SnAgCu bath |  |  |
| Conclusion | 5 units/ split passed the test with no issue reported | |

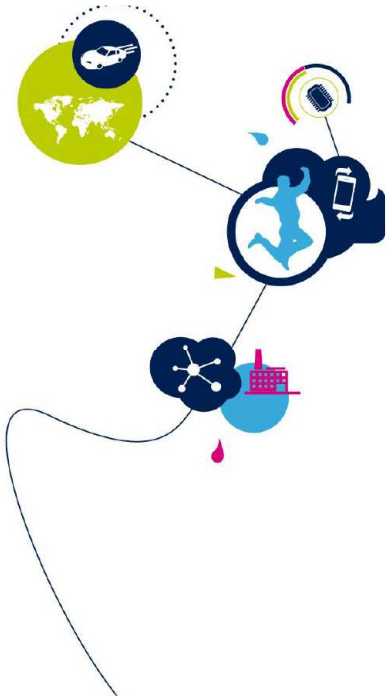
**Test vehicle V912**

Lot ref: CZ7410F3RN

| | After 8h at 85°C/85%RH | After 16h dry air 150°C |
|---|---|---|
| SnPb bath |  |  |
| SnAgCu bath |  |  |
| Conclusion | 5 units/ split passed the test with no issue reported | |

Lead-free Matte tin verification versus whiskers risk

# Whiskers Monitoring Report
# ST BSK LAB: Q1-18



S. CHELLAOUI
K. OULAD BENAISSA

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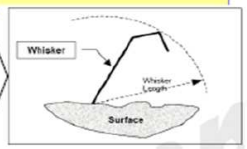
## Whiskers related tests

(According to ST BSK Whiskers acceptance criteria referred to DM00485464)

| | | | |
|---|---|---|---|
| 1. | High temp. / high humidity<br>55 ° C / 85% rel. Hum. | 2000h * | max. 20 µm whisker** |
| 2. | Temperature cycle<br>-40° C / +85° C | 1000TC | max. 45 µm whisker |
| 3. | Ambient Temp./Humidity<br>30 ° C / 60 % rel. Hum. | 2000h * | max. 20 µm whisker |

*In case of whiskers found (even below the Maximum spec. limit ) the test must to continue up to 4000 hrs with the interim read out at 3000 hrs .
**In case of corrosion of solder and whiskers associated , this is not considered failure, therefore the lead in object must be discounted .

Whisker length : The straight line distance from the point of emergence of whiskers of the most distant point on the whiskers ( i.e. the radius of a sphere containing the whiskers with its center located at the point of emergence).

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| Monitoring period | Assy Plant | Requestors | Line | Date of aviability | Recieved by | Date of Report |
|---|---|---|---|---|---|---|
| Q1 / 2018 | STM BOUSKOURA | A. CHEFFAJ | PLT | 10 MARCH 2018 | S CHELLAOUI | 12/10/2018 |
| | | Y. ABOUTOURAB | SMD | 15 MARCH 2018 | | |

| Line | Products | Lot ID | Devices | Plating Machine | Date process plating | Quantity units recieved | Comment |
|---|---|---|---|---|---|---|---|
| PLATING CENTRAL | PSO10 | CZ8060CKRP | V526 | MECO1 | W08 | 50 Units | NO ABNORMALITY ISSUE |
| | PSO10 | CZ8020AKRH | 4D4K | MECO2 | W07 | | |
| | PSSO12 | CZ8060P4RM | VNU1 | MECO3 | W07 | | |
| | PSSO12 | CZ80803SRQ | UH45 | BELT1 | W08 | | |
| | TO220 BOSCH | CZ8080CWRQ | Z06S | MECO2 | W08 | | |
| | TO220 | CZ8070N301 | E35H | MEC03 | W08 | | |
| | TO220 | CZ8060RMRN | MQ6 | BELT3 | W07 | | |
| | VIP BOSCH | CZ8060SX01 | CR665 | BELT3 | W07 | | |
| | SWATT | CZ8050DF01 | L200 | BELT3 | W08 | | |
| | MWATT 11L | CZ80506HRR | [illegible]9 | MECO1 | W07 | | |
| | SO-HD | CZ8030NERP | 0922 | BELT2 | W04 | | NO ABNORMALITY ISSUE |
| | SO8-HD | CZ804008RG | 0911 | BELT1 | W05 | | |
| | SO8-SSHD | CZ8090ADRR | 0158 | MECO4 | W09 | | |
| | SO14-HD | CZ8040M0RJ | V324 | BELT2 | W05 | | |
| | SO14-HD | CZ80802FRK | 0324 | BELT1 | W03 | | |
| | SMA-SHD | CZ8080D6RJ | TFUV6 | MECO4 | W09 | | |
| | SMB-F | CZ8010FKRN | X020 | BELT2 | W03 | | |
| | SMB-F | CZ8010FKRQ | X020 | BELT1 | W03 | | |
| PLATING SMD | SMA | CZ81101E0J | TRANSIL | TPSL002 | W11 | | |
| | SMA | CZ811011RQ | RECTIFIER | TPSL001 | W11 | | |
| | SMB | CZ801010RH | TRANSIL | TPSL001 | W11 | | |
| | SMB | CZ81100WRL | TRANSIL | TPSL002 | W11 | 40 Units | |
| | SMC | CZ8100KK01 | TRANSIL | TPSL002 | W11 | | |
| | SMC | CZ8100KK0F | TRANSIL | TPSL001 | W11 | | |

# Pull test (value in gram)

All failure mode acceptable

| Unit / TV | 393 | V912 | 922 | U494 | 16VA | 0912 | 0431 |
|---|---|---|---|---|---|---|---|
| 1 | 13.6 | 14.672 | 14.636 | 14.452 | 11.664 | 17.587 | 15.01 |
| 2 | 14.6 | 15.453 | 15.453 | 14.304 | 16.251 | 17.609 | 15.36 |
| 3 | 14.2 | 14.465 | 14.079 | 12.545 | 12.737 | 16.638 | 15.21 |
| 4 | 14.7 | 14.426 | 15.042 | 15.496 | 15.761 | 16.381 | 15.24 |
| 5 | 15.4 | 14.01 | 14.903 | 14.476 | 11.715 | 15.957 | 15.42 |
| 6 | 13.8 | 16.027 | 15.701 | 15.011 | 13.81 | 17.179 | 14.99 |
| 7 | 14.9 | 16.432 | 15.509 | 17.319 | 13.608 | 17.377 | 14.79 |
| 8 | 12.9 | 14.368 | 15.425 | 15.382 | 12.138 | 17.856 | 15.21 |
| 9 | 14.8 | 15.751 | 14.898 | 14.678 | 13.941 | 15.283 | 13.98 |
| 10 | 13.3 | 16.432 | 14.49 | 14.307 | 15.261 | 16.984 | 15.02 |
| 11 | 14.2 | 14.265 | 14.823 | 13.176 | 14.698 | 17.817 | 13.51 |
| 12 | 13.1 | 15.338 | 14.563 | 15.617 | 14.527 | 15.021 | 15.21 |
| 13 | 14.6 | 15.551 | 14.378 | 16.618 | 12.306 | 16.867 | 14.11 |
| 14 | 13.8 | 15.813 | 15.265 | 14.114 | 11.938 | 16.542 | 13.44 |
| 15 | 13.8 | 14.037 | 14.656 | 15.627 | 13.08 | 17.162 | 14.11 |
| 16 | 14.3 | 14.008 | 14.934 | 15.535 | 12.499 | 17.26 | 14.17 |
| 17 | 13.7 | 16.952 | 14.941 | 14.309 | 15.726 | 15.135 | 14.35 |
| 18 | 14 | 14.233 | 15.115 | 10.447 | 14.834 | 17.34 | 14.37 |
| 19 | 14.7 | 16.103 | 14.219 | 13.889 | 15.188 | 16.894 | 14.36 |
| 20 | 15.9 | 15.377 | 15.173 | 14.102 | 11.412 | 17.818 | 13.69 |
| 21 | 15.4 | 15.781 | 16.422 | 16.117 | 13.671 | 16.746 | 15.15 |
| 22 | 13.6 | 16.52 | 14.589 | 16.464 | 12.423 | 16.009 | 14.7 |
| 23 | 15.1 | 16.565 | 13.446 | 11.319 | 13.25 | 16.114 | 12.97 |
| 24 | 15.2 | 16.153 | 16.097 | 14.759 | 14.596 | 16.025 | 13.2 |
| 25 | 12.9 | 15.985 | 14.468 | 16.151 | 14.806 | 17.144 | 13.74 |
| 26 | 14.5 | 13.981 | 13.235 | 14.809 | 16.194 | 15.334 | 14.02 |
| 27 | 12.4 | 14.33 | 15.869 | 12.718 | 14.522 | 17.195 | 15.11 |
| 28 | 12.9 | 15.985 | 14.468 | 16.151 | 14.806 | 17.144 | 13.35 |
| 29 | 14.5 | 13.981 | 13.235 | 14.809 | 16.194 | 15.334 | 13.25 |
| 30 | 12.4 | 14.33 | 15.869 | 12.718 | 14.522 | 17.195 | 14.61 |
| 31 | 13.6 | 15.079 | 14.661 | 16.078 | 11.821 | 17.048 | 14.98 |
| 32 | 13.23 | 15.526 | 15.999 | 15.921 | 13.03 | 15.915 | 14.6 |
| 33 | 12.09 | 14.864 | 14.389 | 14.046 | 13.7 | 16.995 | 16.2 |
| **mean** | **14.0** | **15.2** | **14.9** | **14.7** | **13.8** | **16.7** | **14.5** |
| **stddev** | **0.94** | **0.91** | **0.76** | **1.49** | **1.44** | **0.81** | **0.77** |
| **Cpk** | **3.56** | **4.11** | **4.78** | **2.38** | **2.28** | **5.19** | **4.52** |

# Shear test (value in gram)

All failure mode acceptable

| Unit / TV | 393 | V912 | 922 | U494 | 16VA | 0431 | 0912 |
|---|---|---|---|---|---|---|---|
| **1** | 37.4 | 33.31 | 32.73 | 36.896 | 32.616 | 32.35 | 32.35 |
| **2** | 30.4 | 36.67 | 36.46 | 34.027 | 36.157 | 32.55 | 29.17 |
| **3** | 37.7 | 35.22 | 35.01 | 37.666 | 35.672 | 35.11 | 31.8 |
| **4** | 36.3 | 36.2 | 35.55 | 38.577 | 33.409 | 30.25 | 32.34 |
| **5** | 30.3 | 33.38 | 34.55 | 39.49 | 35.665 | 30.99 | 33.03 |
| **6** | 33.8 | 36.16 | 34.96 | 43.477 | 34.332 | 34.02 | 31.53 |
| **7** | 33.4 | 35.76 | 32.62 | 40.777 | 37.463 | 31.31 | 31.4 |
| **8** | 29.1 | 33.57 | 32.61 | 36.792 | 34.529 | 31.65 | 32.94 |
| **9** | 31.2 | 33.69 | 35.94 | 39.999 | 36.368 | 32.51 | 31.02 |
| **10** | 33.8 | 32.33 | 33.07 | 37.303 | 35.716 | 30.51 | 32.88 |
| **11** | 33.2 | 34.12 | 32.95 | 36.429 | 37.593 | 32.11 | 31.79 |
| **12** | 30.2 | 33.26 | 36.35 | 41.61 | 35.997 | 34.02 | 32.66 |
| **13** | 30.6 | 33.03 | 35.42 | 39.354 | 35.229 | 35.02 | 32.62 |
| **14** | 34.7 | 35.67 | 36.34 | 34.663 | 37.549 | 33.41 | 32.86 |
| **15** | 34.2 | 32.38 | 34.6 | 39.124 | 34.581 | 35.21 | 32.7 |
| **16** | 32.8 | 35.91 | 34.74 | 34.463 | 38.432 | 36.21 | 31.46 |
| **17** | 33.9 | 33.51 | 34.56 | 36.495 | 35.111 | 36.91 | 30.12 |
| **18** | 33.9 | 35.96 | 34.21 | 37.507 | 34.353 | 40.12 | 31.47 |
| **19** | 33.9 | 36.31 | 33.56 | 38.906 | 34.877 | 33.38 | 31.86 |
| **20** | 30.6 | 35.14 | 35.94 | 36.378 | 35.99 | 31.83 | 33.01 |
| **21** | 38.9 | 36.35 | 33.87 | 38.274 | 33.866 | 34.15 | 31.61 |
| **22** | 33 | 36.58 | 36.57 | 35.377 | 32.912 | 33.74 | 32.37 |
| **23** | 34.3 | 35.22 | 35.73 | 39.367 | 35.678 | 36.09 | 31.09 |
| **24** | 37.1 | 34.89 | 35.02 | 41.16 | 33.921 | 36.18 | 32.69 |
| **25** | 30.4 | 33.35 | 33.65 | 38.662 | 34.133 | 36.36 | 32.26 |
| **26** | 36.2 | 34.58 | 33.54 | 38.292 | 35.004 | 36.39 | 29.13 |
| **27** | 34.3 | 33.31 | 34.87 | 41.859 | 36.838 | 34.58 | 29.8 |
| **28** | 30.4 | 33.35 | 33.65 | 38.662 | 34.133 | 37.57 | 32.26 |
| **29** | 36.2 | 34.58 | 33.54 | 38.292 | 35.004 | 35.79 | 29.13 |
| **30** | 34.3 | 33.31 | 34.87 | 41.859 | 36.838 | 39.73 | 29.8 |
| **31** | 35.2 | 33.87 | 34.98 | 42.42 | 37.448 | 32.3 | 31.44 |
| **32** | 33.3 | 32.47 | 34.74 | 35.713 | 36.472 | 36.2 | 31.09 |
| **33** | 33.9 | 31.48 | 35.43 | 39.333 | 34.733 | 34.24 | 33.19 |
| **mean** | **33.6** | **34.4** | **34.6** | **38.5** | **35.4** | **34.3** | **31.7** |
| **stddev** | **2.44** | **1.43** | **1.15** | **2.34** | **1.41** | **2.42** | **1.19** |
| **Cpk** | **1.82** | **3.30** | **4.15** | **2.59** | **3.58** | **1.94** | **3.19** |

# Physical dimension

**Test vehicle 0393**

**CZ7410EHR0**

| Dimensions (mm) | Specifi-cation | Data | | | | | |
|---|---|---|---|---|---|---|---|
| items: | min. | max. | Min. | Max. | Mean | StDev | Cpk |
| Dambar Protrusion | | 0.120 | 0.027 | 0.071 | 0.051 | 0.010 | 1.68 |
| Lead Width | 0.375 | 0.425 | 0.395 | 0.416 | 0.403 | 0.004 | 1.76 |
| Coplanarity | | 0.040 | 0.002 | 0.016 | 0.006 | 0.004 | 3.21 |
| Stand Off | 0.120 | 0.180 | 0.141 | 0.160 | 0.152 | 0.005 | 1.99 |
| Foot length | 0.567 | 0.667 | 0.641 | 0.654 | 0.646 | 0.004 | 1.88 |
| Lead tip to tip | 5.900 | 6.100 | 6.020 | 6.060 | 6.034 | 0.008 | 2.62 |
| K (angle) | 3.000 | 7.000 | 4.200 | 5.500 | 4.723 | 0.351 | 1.64 |

**Test vehicle V912**

**CZ7410F3RN (NN)**

| Dimensions (mm) | Specification | | Data | | | | |
|---|---|---|---|---|---|---|---|
| items: | min. | max. | Min. | Max. | Mean | StDev | Cpk |
| Side Flash | 0.020 | 0.250 | 0.132 | 0.153 | 0.144 | 0.006 | NA |
| Dambar Protrusion | | 0.120 | 0.027 | 0.071 | 0.051 | 0.010 | 1.675 |
| Lead Width | 0.375 | 0.425 | 0.395 | 0.416 | 0.403 | 0.004 | 1.763 |
| Coplanarity | | 0.040 | 0.002 | 0.016 | 0.006 | 0.004 | 3.210 |
| Stand Off | 0.120 | 0.180 | 0.141 | 0.160 | 0.152 | 0.005 | 1.988 |
| Foot length | 0.567 | 0.667 | 0.641 | 0.654 | 0.646 | 0.004 | 1.881 |
| Lead tip to tip | 5.900 | 6.100 | 6.020 | 6.060 | 6.034 | 0.008 | 2.615 |
| K (angle) | 3.000 | 7.000 | 4.200 | 5.500 | 4.723 | 0.351 | 1.636 |

**Test vehicle 0922**

| Dimensions (mm) | Specification | | Data | | | | |
|---|---|---|---|---|---|---|---|
| items: | min. | max. | Min. | Max. | Mean | StDev | Cpk |
| Dambar Protrusion | | 0.120 | 0.027 | 0.071 | 0.051 | 0.010 | 1.675 |
| Lead Width | 0.375 | 0.425 | 0.395 | 0.416 | 0.403 | 0.004 | 1.763 |
| Coplanarity | | 0.040 | 0.002 | 0.016 | 0.006 | 0.004 | 3.210 |
| Stand Off | 0.120 | 0.180 | 0.141 | 0.160 | 0.152 | 0.005 | 1.988 |
| Foot length | 0.567 | 0.667 | 0.641 | 0.654 | 0.646 | 0.004 | 1.881 |
| Lead tip to tip | 5.900 | 6.100 | 6.020 | 6.060 | 6.034 | 0.008 | 2.615 |
| K (angle) | 3.000 | 7.000 | 4.200 | 5.500 | 4.723 | 0.351 | 1.636 |

# 6 ANNEXES

## 6.1 Tests Description

| Test name | Description | Purpose |
|---|---|---|
| **Die Oriented** | | |
| **HTOL** High Temperature Operating Life<br><br>**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.<br>The typical failure modes are related to, silicon degradation, wire-bonds degradation, oxide faults. |
| **HTRB** High Temperature Reverse Bias<br><br>**HTFB / HTGB** 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** 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** 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** 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** 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. |

| Test name | Description | Purpose |
|---|---|---|
| **TF / IOL** 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** 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** 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** 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. |