sensL
sense light

# Handling and Soldering of SensL TSV Devices

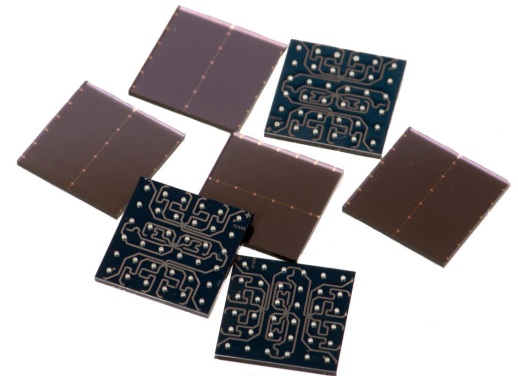
## Introduction

This document contains information on the handling, storage and soldering of the SensL TSV (through silicon via) packaged sensors, as well as the schematics of tapes and reels that they are shipped in.

This document applies to the following devices:

- MicroFJ-*XXXXX*-TSV

where the *X*s represent number in the part number. The TSV package is fabricated while the die are still on the wafer. A glass substrate is bonded to the top of the silicon wafer and the silicon is back-ground to a thin layer (<0.10mm). Contact vias are then etched in the silicon, oxide is deposited to isolate the substrate from further processing and metal is deposited to form a layer contact with the output terminals of the SiPM. Solder bumps are then attached to the deposited metal on the back side of the sensor. The wafer is finally sawn into individual die. The TSV concept is shown in Figure 1 on the right.



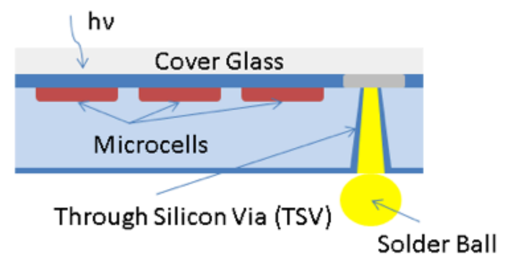



*Figure 1, The SensL TSV package*

## Applicable Documents

IPC/JEDEC J-STD-020; IPC/JEDEC J-STD-033.

## Safe Handling of TSV Sensors

- Remember that the SiPM is a sensitive optoelectronic instrument and should always be handled as carefully as possible. Physical contact with the sensor should be minimized during assembly and SensL recommend the use of automatic assembly directly from reels. Contact with the sensitive surface, which is glass, should be avoided. In particular, care should be taken to avoid contact with abrasive materials.
- When unpacking, care should be taken to prevent dropping or misorienting the sensors.
- SiPM sensors are ESD sensitive. The following precautions are recommended:

  - Ensure that personal grounding, environmental controls and work surfaces are compliant with recommendations in JESD625.
  - Ensure that all personnel handling these devices are trained according to the recommendations in JESD625.
  - Devices must be placed in an ESD approved carrier during transport through an uncontrolled area.
- The sensor should be disconnected from the bias supply when not in use.
- See the ‘Cleaning’ section on page 4 for advice on exposure to cleaning agents.

## Storage Conditions

TSV devices are moisture sensitive. If not stored correctly moisture can diffuse into the package from atmospheric humidity. Surface mount soldering of the TSV packages to PCB exposes the entire package body to temperatures up to 260°C. Rapid expansion of any trapped moisture during this process could result in package cracking or delamination of critical interfaces within the package.

To avoid this, parts are shipped in moisture barrier bags (MBBs) according to J-STD-033 standard. Unopened MBBs should be stored at a temperature below 40°C with relative humidity <90%. After the MBB has been opened, the devices must be reflow soldered within a period of time depending upon the moisture sensitivity level (MSL). SensL TSV parts on Tape & Reel are MSL 3 (see Table 1 for details).

| TSV shipping format | MSL | Exposure time | Condition | Calculated shelf life in sealed bags* | Peak package body temperature |
|---|---|---|---|---|---|
| Tape and reel | 3 | 168 hours | ≤30°C/60% RH | 24 months (<40°C and <90% RH) | 260°C |
| Cut tape and partial reels | 4 | 72 hours | ≤30°C/60% RH | 12 months (<40°C and <90% RH) | 260°C |
| Gel pack or waffle pack | N/A | Indefinite | Always follow the > 72 h bake instruction on the next page | N/A | N/A |

*Table 1, MSL definitions applicable to SensL TSV parts (reference J-STD-20).*

** Calculated shelf life is based on the packing date at the manufacturer. This 'bag seal date' is displayed on the reel's Moisture Sensitivity Label, the location of which can be found on pages 6 and 8 of this document. SensL guarantees that reels will ship with a minimum of 3 months left before the expiry date of the MBB (according to the packing date and shelf life on the label).*

The parts must also be baked (according to J-STD-033, table 4.1) if any of the following occurs:

1. The parts are not reflow soldered within the applicable exposure time of opening the MBB (see Table 1).
2. The MBB is expired (according to the packing date and shelf life on the label).
3. The humidity indicator card (HIC) shows the moisture level within the MBB has increased beyond the required level.
4. The parts are shipped with a bake instruction note.

## Rebake Conditions

If any of the conditions on page 2 occurs then a rebake is required, according to J-STD-033, table 4.1. The information in Table 2, below, should also be taken into account.

| Condition | Rebake procedure if the exposure time exceeds the floor life expectation by... | |
|---|---|---|
| | > 72 hours | < 72 hours |
| Not on tape | 33 hours at 90℃ | 23 hours at 90℃ |
| On tape | 13 days at 40℃ | 9 days at 40℃ |

*Table 2, Rebake procedures for TSV devices on tape and not on tape.*

## Solder Reflow Conditions

The TSV package is compatible with standard reflow solder processes (J-STD-20) and so is ideal for high-volume manufacturing. SensL TSV sensors should be mounted according to specified soldering pad patterns. Recommended solder footprints are given in the relevant product CAD files which are linked to from the product datasheets, and are also linked to on the final page of this document. If the TSV part is being assembled into an array, the advice in the Array Design Tech Note should be followed.

Physical contact with the sensor should be minimized during assembly and SensL recommend the use of automatic assembly directly from reels. Contact with the sensitive surface, which is glass, should be avoided. In particular, care should be taken to avoid contact with abrasive materials.

Solder paste (we recommend using no-clean solder paste) must be evenly applied to each soldering pad to insure proper bonding and positioning of the component. After soldering, allow at least three minutes for the component to cool to room temperature before further operations. Solder reflow conditions must be in compliance with J-STD-20, table 5.2. This is summarized in Figure 2. The number of passes should not be more than 2.

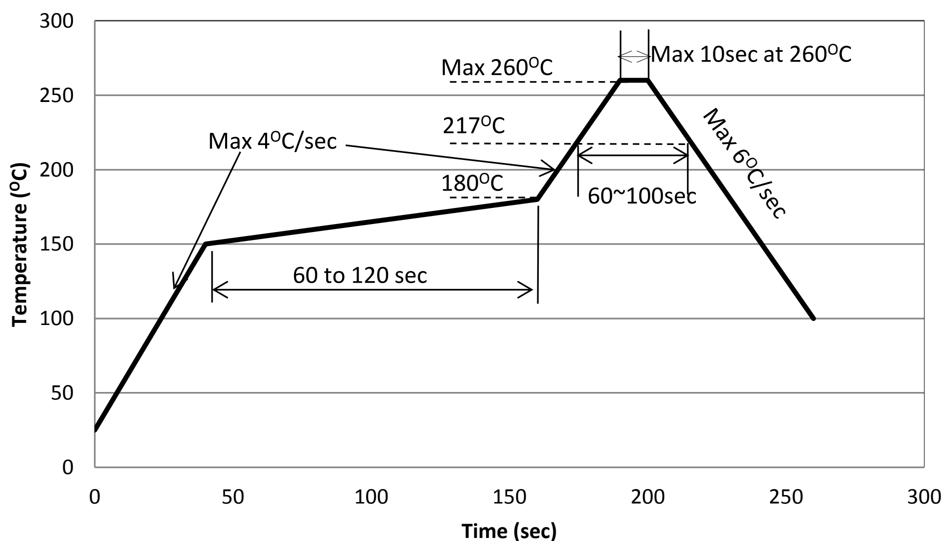



*Figure 2, Solder reflow profile*

## Cleaning

Isopropyl alcohol (propan-2-ol) in concentrated form can be used for cleaning of the TSV devices.

It is important to allow the PCB to cool to room temperature after reflow and before flux cleaning in order to avoid excessive thermal shock.

## Rework of the TSV Packages

Manual rework of TSV packages after reflow soldering is not recommended. Manual removal of surface mount components from a PCB involves heating to temperatures above 250˚C for long periods (>60 seconds) with minimal process controls. Such treatment will result in internal damage to the package and increased failure rate.

It is possible to remove, discard and replace components where the packing density of devices is sufficiently low to prevent excessive heating of adjacent components during removal of the component of interest. Rework of densely packed components (such as an array) can be achieved using semi-automated equipment such as Metcal APR-5000. Such equipment enables control of the reflow profile and removal of the component using a vacuum collet.

## CAD and Solder Footprints

The MicroFJ-**30020**-TSV-A1 CAD, including tape and reel, and solder footprint, is available to download here.

The MicroFJ-**30035**-TSV-A2 CAD, including tape and reel, and solder footprint, is available to download here.

This PCN describes the changes to the tape and reel between revisions A1 and A2.

The MicroFJ-**60035**-TSV-A2 CAD, including tape and reel, and solder footprint, is available to download here.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*All specifications are subject to change without notice*

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