# MEMS MIC Assembly and Handling Guidelines

## INTRODUCTION

Cirrus MEMS microphones are compatible with existing industrial Surface Mount Technology (SMT) processes. Specific recommendations and procedures must be observed as the microphone incorporates an acoustic port hole open to the environment for sound pick up.

This application note offers information about the recommended handing and assembly guidelines to maximise manufacturing throughput in production and minimise the possibility of defects due to PCB rework on the bench.

## STORAGE

All Cirrus MEMS microphones supplied in a drybag are classified as Moisture Sensitive Level (MSL) 2a, in line with IPC/JEDEC J-STA-020. The drybag is filled with dry air and contains a moisture absorbing material. Figure 1 shows a typical label attached to the dry bag giving further instructions to end users concerning the MSL Level, storage and re-bake conditions.

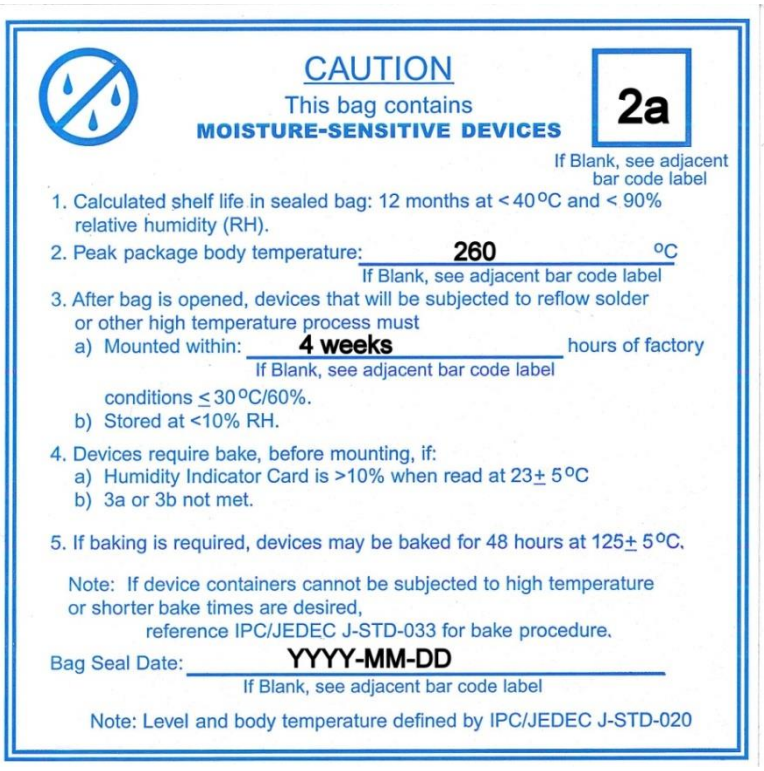


**Figure 1 Drybag Label Example for MSL Level 2a**

As part of good practice, all incoming shipments should be carefully inspected before opening for any damage, puncture or signs of air leakage of the microphone drybag as shown in Figure 2 . Any air-leakage in the microphone drybag may indicate vacuum shock to the microphone during shipment. Any damaged or punctured microphone dry bags should be separated away from production processes.

Open drybag quantities should be stored in dry nitrogen chambers. Care should be taken to avoid damage to the MEMS microphone by any methods of vacuum storage or potential ESD stress.

**Figure 2 Air-Leakage of Microphone Drybag**

## MANUAL HANDLING

In addition to general guidelines for IC handing, additional care should be taken to avoid any vacuum and excessive mechanical stress, or contamination entering the microphone porthole.

For PCB rework, prototyping or manual assembly and handling processes:

- All manual processes should be carried out on ESD grounded work stations.
- Sharp objects of any type should not be used to pierce into the microphone port hole. In general the microphone should only be handled from the side.
- For some microphones, the base of the microphone is a PCB substrate to which the metal lid is attached. Do not use excessive force on the edges or use tools like a scalpel for delamination of microphone package layers. Note that Cirrus cannot accept the return of products that have been inadequately handled.
- Vacuum tweezers are not recommended as a high level of vacuum stress can damage the MEMS transducer.
- Use static shield bags or ESD bags for microphone samples handling. Avoid conductive IC boxes for microphone storage as loose foam material can get into the microphone port hole.
- Pocket-less gel packs with adhesive gel layer are ideal to hold the microphone in position, care should be taken to remove the dust on the gel surface before using it for microphone samples handling and storage.
- Do not board brush, use an airgun or hot air blower directly over the microphone acoustic port hole during PCB repair or rework of microphone or other adjacent components on the board.
- A small stencil for the microphone soldering is recommended to ensure accurate and precise control of solder paste applied on the pad before soldering. The shaded regions in Figure 3 show the stencil design of WM7210. In this example, the solder paste for the perimeter ground pad is only applied to the 4 edges or outer shaded locations to secure the solder paste application of internal 4 pads on the stencil design. Further recommendations on the stencil and solder paste are available in Table 1.

| SOLDERING RECOMMENDATIONS | |
|---|---|
| Stencil thickness and preparation | 100± 25um, laser cut and electro-polished. |
| Stencil dimension | The stencil should be 1:1 or 90% of the PCB size. The sidewalls of the stencil opening should be tapered approximately 5° to facilitate better paste release |
| Solder paste | Type 4- alloy composition – Sn/Ag3.0/Cu0.5 |
| Flux | Use No Clean Flux to avoid board cleaning |

**Table 1 Typical Soldering Recommendations**

- Manual soldering should be avoided if possible, as it is difficult to ensure accurate temperature control. In general, it is recommended to start from lowest temperature possible or typically 240°C.
- Use of an infra-red rework station is highly recommended for any PCB rework with microphones, as it provides precise control of temperature profile and process repeatability. It is recommended only to use trained person on the rework station to ensure a high standard of soldering quality.
- Do not employ chemical board wash or cleaning, as the associated cleaning agents can damage the device.
- Do not expose to any ultrasonic cleaning method.

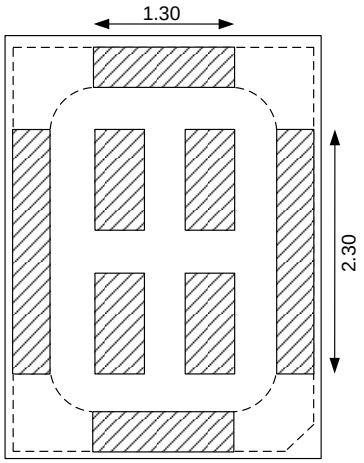


**Figure 3 WM7210 Stencil Design**

## PICK AND PLACE

The Pick and Place (PnP) process uses vacuum pressure and a nozzle for accurate placement of microphones on the PCB. Note that drawing a vacuum over the port hole may cause damage to the device. Therefore, extreme care should be taken to avoid any direct contact or moving the nozzle over the microphone port hole.

- For all top port microphones, the recommended vacuum point is noted in the datasheet on the package diagram. This is illustrated using WM7120A as an example in Figure 4 and Figure 5.
- For bottom port microphones, the PnP nozzle may handle the microphone at the centre point on the top side of the package.
- Avoid using excessive force in the PnP process.
- Avoid high shock events above 10,000g.
- Common nozzle size to handle 0603 components or smaller can be used for microphones as a starting point for setting up the PnP process.

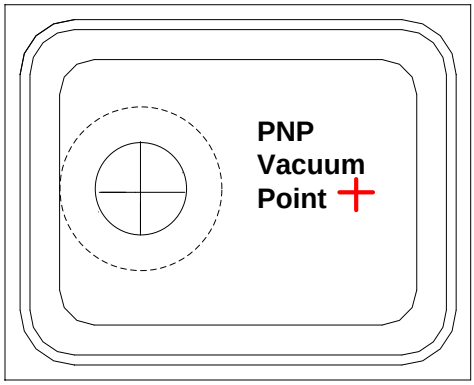


**Figure 4 WM7120A with Recommended PnP Vacuum Point**

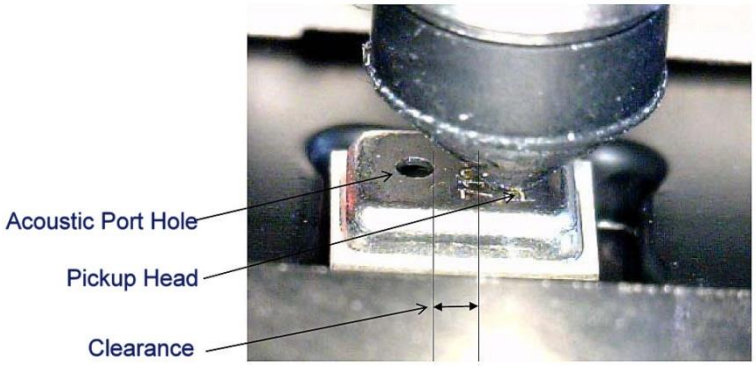


**Figure 5 Nozzle Pickup of WM7120A Microphone**

## SOLDER REFLOW

As any practical manufacturing process depends on the assembly production capability, the PCB size, board configuration, solder paste, and other components on the board, the limits described in JEDEC standard J-STD-020 should be considered as upper limits for the value tested in components qualification. Precise fine tuning of the solder reflow process by the process engineer is necessary to reduce excessive thermal stress.

Since Cirrus MEMS microphones are fully compliant to the JEDEC solder reflow process without any special requirements, the profile provided by the solder supplier should be used as a basis of the process and adjusted accordingly to the target board. In general, the solder reflow process consists of four phases as shown in Figure 6:

- Pre heat
- Soak (and flux activation)
- Reflow
- Cool down

Summary of critical areas:

- There are two zones of ramp up gradient with typical ramp up rate at about 1°C/sec. In the pre heat zone, the board temperature ramps up from 25°C to 200°C. This ramp up gradient stabilizes the temperature evenly across the board, the second ramp up gradient activates the solder paste and flux through the soak phase, and continues up to $T_p$ (peak temperature). $T_p$ at the microphone should not exceed 260°C
- Care must be taken to avoid a sudden change in temperature gradient from any phase transitions above to avoid component damage and soldering defects.
- The reflow zone is the most critical, where the actual melting and soldering are taking place from $T_L$ (liquidus temperature) up to $T_p$ $\mathrm{T_p}$. Extreme care is necessary to avoid the board remaining too long above $T_L$, avoid long periods at $T_p$ and too high at temperature above the recommended $T_p$ as shown in Table 2.
- In the cool down zone, the 1°C/s to 3°C/s cool down rate ensure the PCB, the components, and the solder joints cool down in a controlled and even manner.
- On average the whole solder reflow process takes about 6 to 7 minutes.
- Allocate the MEMS microphone to the last reflow soldering operation if possible.
- Do not employ chemical board wash or cleaning, as the associated cleaning agents can damage the device.
- Do not use physical cleaning and do not expose to ultrasonic cleaning methods or air guns.
- Do not use Vapour Phase Re-flow process for MEMS microphone, as the vapour can damage the MEMS microphone through the port hold.

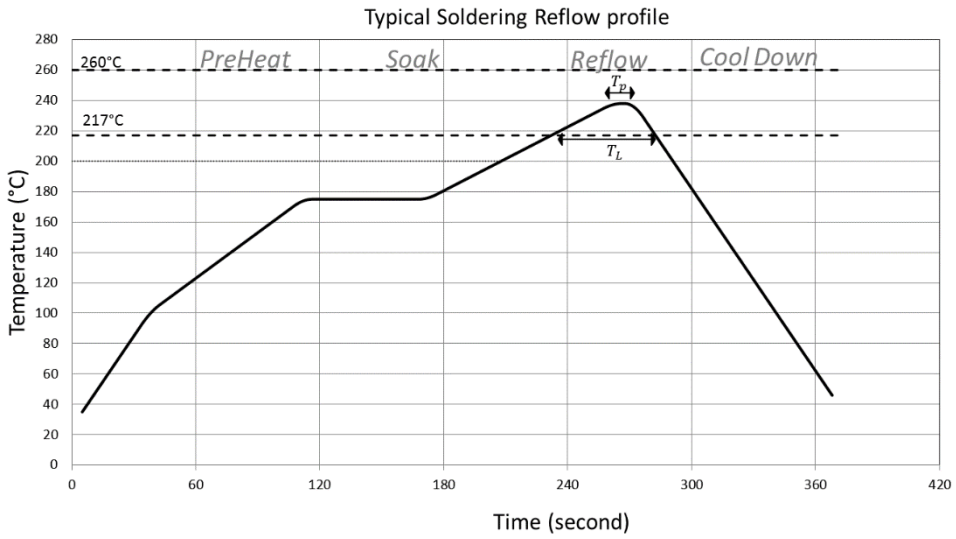


**Figure 6 Typical Solder Reflow Profile**

| LEAD-FREE SOLDER PROFILE FEATURE | |
|---|---|
| Average Ramp-up | ~1°C/second |
| Pre heat (100 to 200°C) | 60 to120 seconds |
| Time maintained above $T_L$ (217°C) | ≤ 60 seconds |
| Peak temperature $T_p$ | ≤ 260°C |
| Time at Peak temperature $T_p$ | < 10 seconds |
| Cool-Down rate | ~3°C/second max |

**Table 2 Typical Lead-free Solder Reflow Parameters**

## SUMMARY

This application note focuses on the prevention of potential damage of MEMS microphone due to mechanical, vacuum and thermal stress in handling process. Adaptation and adjustment to the recommendations contained in this application note is necessary according to specific PCB constraints and manufacturing environments.

## REFERENCE

http://www.jedec.org/

## Contacting Cirrus Logic Support

For all product questions and inquiries, contact a Cirrus Logic Sales Representative.
To find one nearest you, go to www.cirrus.com.