

MEMS Microphone Handling and Assembly Guide

PURPOSE AND SCOPE

This document provides information and general guidelines for handling and assembling boards with InvenSense Micro Electro-Mechanical Systems (MEMS) microphones.

REFLOW SOLDERING AND BOARD ASSEMBLY

PRINTING PARAMETERS

The recommended solder paste printing parameters are

- Print pressure = 3 kg
- Print speed = 30 mm/sec
- Squeegee type = metal
- Squeegee angle = 60°

SOLDER PASTE STENCIL PARAMETERS

The solder paste stencil parameters are

- Stencil type = laser cut
- Stencil thickness = 3 mils (~75 µm)

SUGGESTED SOLDER PASTE

The suggested solder paste is Indium8.9 (Type 4—alloy composition—96.5Sn/3.0Ag/0.5Cu (SAC305)). This paste is an air reflow, no-clean solder paste specifically formulated to accommodate the higher processing temperatures required by the Sn/Ag/Cu, Sn/Ag, and other alloy systems favored by the electronics industry to replace conventional Pb-bearing solders.

PLACEMENT FORCE

MEMS microphones can be handled using standard pick-and-place and chip shooting equipment. Care should be taken to avoid damage to the MEMS microphone structure as follows:

- Use a standard pickup tool to handle the microphone. On bottom-port microphones where the hole is on the bottom of the package, the pickup tool can make contact with any part of the lid surface.
- The size of the pickup tool should be no smaller than the size of the package. This will prevent denting of the lid during mounting.
- Do not pick up the microphone with a vacuum tool that makes contact with the microphone's sound port.
- Do not pull air out of or blow air into the microphone port.
- Do not use excessive force (>1 kg) to place the microphone on the PCB.

TAPING THE PORT HOLE

Tape can be placed over the microphone port hole during the assembly process to minimize contaminants getting into the microphone. This tape should be added to the board following reflow; applying before reflow is not recommended because the high temperatures during the solder reflow process will result in the trapped air expanding.

The tape should be removed before final testing. When removing the tape from the PCB, it should be peeled off slowly so as not to create a very high pressure at the microphone port.

InvenSense recommends not to blow on either a microphone or PCB assembly with high-pressure air, such as from an air gun or compressed air canister. Even if the microphone's port hole is taped, we do not recommend using high-pressure air.

REFLOW PROFILE

InvenSense products are qualified in accordance with IPC/JEDEC J-STD-020D.1. This standard classifies proper packaging, storage and handling in order to avoid subsequent thermal and mechanical damage during the solder-reflow attachment phase of PCB assembly.

The qualification preconditioning process specifies a sequence consisting of a bake cycle, a moisture soak cycle (in a temperature humidity oven), and three consecutive solder reflow cycles, followed by functional device testing.

The peak solder reflow classification temperature requirement for package qualification is ($260^{\circ}\text{C} + 0^{\circ}\text{C}/-5^{\circ}\text{C}$) for lead-free soldering of components measuring less than 1.6 mm in thickness. The qualification profile and a table explaining the set points are shown below. The reflow profile in Figure 1 is recommended for board manufacturing with InvenSense MEMS microphones. These microphones are also compatible with the profile described in J-STD-020D.1.

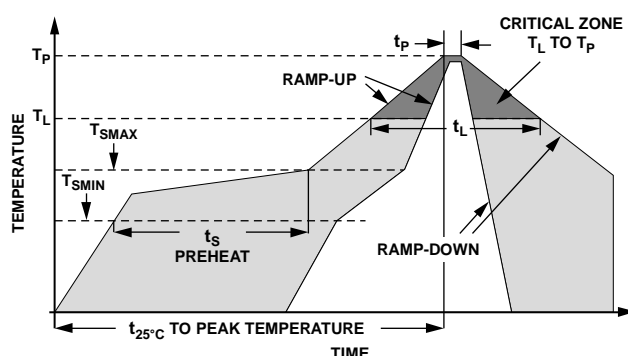


Figure 1. Recommended Soldering Profile Limits

TABLE 1. RECOMMENDED SOLDERING PROFILE LIMITS

Profile Feature	Sn-Pb	Pb-Free
Average Ramp Rate (T_L to T_P)	1.25°C/sec max	1.25°C/sec max
Preheat		
Minimum Temperature (T_{SMIN})	100°C	100°C
Maximum Temperature (T_{SMAX})	150°C	200°C
Time (T_{SMIN} to T_{SMAX}), t_S	60 sec to 75 sec	60 sec to 75 sec
Ramp-Up Rate (T_{SMAX} to T_L)	1.25°C/sec	1.25°C/sec
Time Maintained Above Liquidus (t_L)	45 sec to 75 sec	~50 sec
Liquidus Temperature (T_L)	183°C	217°C
Peak Temperature (T_P)	215°C +3°C/-3°C	260°C +0°C/-5°C
Time Within 5°C of Actual Peak Temperature (t_P)	20 sec to 30 sec	20 sec to 30 sec
Ramp-Down Rate (T_P to T_L)	3°C/sec max	3°C/sec max
Time 25°C ($t_{25^{\circ}\text{C}}$) to Peak Temperature	5 minutes max	5 minutes max

REWORK

The rework process of the MEMS microphone should be carried out using a rework station.

1. Place the PCB with the microphone on a soldering hot plate.
2. Heat the PCB so that the solder becomes liquidous.
3. Use fine-tipped tweezers to remove the microphone from the PCB.
4. Apply additional solder paste to pad sites using a manually operated dispensing system, such as a syringe with a small-gauge tip.
5. Use a surface-mount placement machine to place the replacement component.
6. Reflow the component on the rework station.

CAUTION

The MEMS microphone package has a port hole opening that is sensitive to solder flux. Do not use a vapor phase soldering process. The MEMS microphone can be damaged if subjected to cleaning processes. The cleaning solvents can enter through the port hole and damage the device.

SOLDER FOOTPRINT AND PASTE MASKS

Figure 2 and Figure 3 show examples of a suggested InvenSense microphone PCB land pattern and solder paste mask. See the data sheets for specific layouts for each microphone. Ensure that the PCB and solder mask design that you use follows the design rules of your specific fab and/or assembly house.

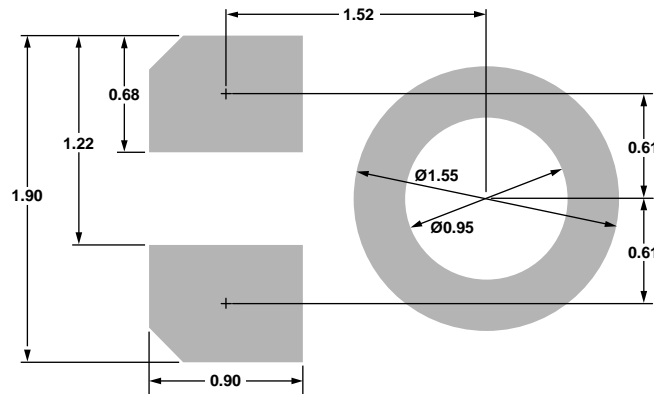


Figure 2. PCB Land Pattern Layout
Dimensions shown in millimeters

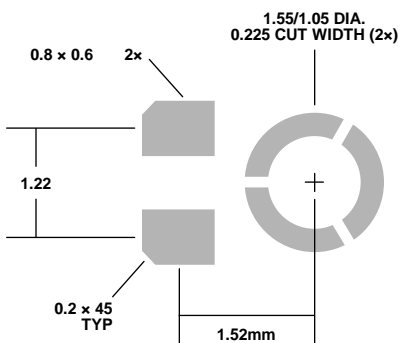


Figure 3. Suggested Solder Paste Stencil Pattern Layout
Dimensions shown in millimeters

HANDLING INSTRUCTIONS

MEMS HANDLING

Unlike conventional IC products in similar packages, MEMS devices contain moving micromechanical structures. Therefore, MEMS devices require different handling precautions than conventional ICs prior to mounting onto PCBs.

InvenSense products have been qualified to a shock tolerance of 10,000g. Furthermore, the products are shipped in cushioned packaging to protect them from potential damage induced by normal handling and shipping.

- Do not drop individually packaged sensors or reels of sensors.
- PCBs that incorporate mounted sensors should not be separated by manually snapping apart. This could also create *g*-forces in excess of 10,000g.
- Do not clean MEMS sensors in ultrasonic baths.
- Do not open and remove MEMS devices from the moisture barrier bag until you are ready to use them. The moisture barrier bag provides good protection to the MEMS sensors during storage and transfer.
- Devices dropped during handling should not be used.

ESD CONSIDERATIONS

Establish and use ESD-safe handling precautions when unpacking and handling ESD-sensitive devices.

- Store ESD sensitive devices in ESD safe containers until ready for use. The Tape-and-Reel moisture-sealed bag is an ESD approved barrier. The best practice is to keep the units in the original moisture sealed bags until ready for assembly.
- Ensure that all workstations and personnel are properly grounded to prevent ESD. Contact InvenSense for the ESM-MM (Machine Model) rating of each individual microphone product. Restrict all device handling to ESD protected work areas that measure less than the static charge for the specific microphone's rating.

STORAGE SPECIFICATIONS

InvenSense products conform to the storage specifications of IPC/JEDEC J-STD-020D.1. All InvenSense microphones are rated at MSL1 except for the INMP521, which is rated at MSL3.

TABLE 2. HANDLING CONDITIONS FOR DIFFERENT MSL RATINGS

Rating	After opening moisture-sealed bag
MSL 1	Unlimited (Storage Conditions: Ambient $\leq 30^{\circ}\text{C}$ at 85%RH)
MSL 3	168 hours (Storage Conditions: Ambient $\leq 30^{\circ}\text{C}$ at 60%RH)
MSL 5	48 hours (Storage Conditions: Ambient $\leq 30^{\circ}\text{C}$ at 60%RH)

PACKAGING SPECIFICATIONS

TAPE AND REEL

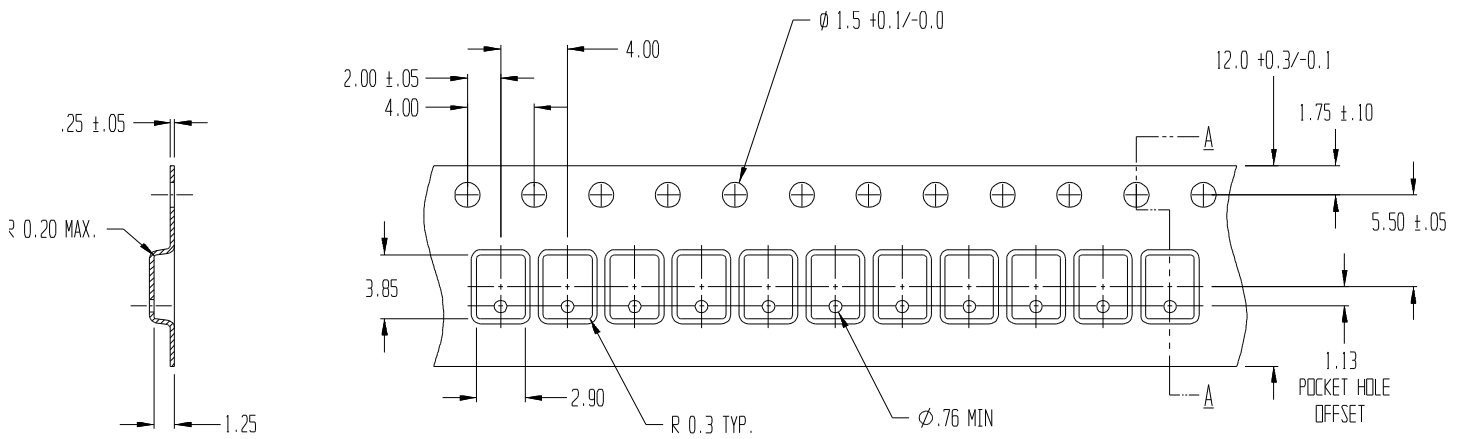


Figure 4. Tape for 3.35 × 2.5 mm Packages (all dimensions in mm)

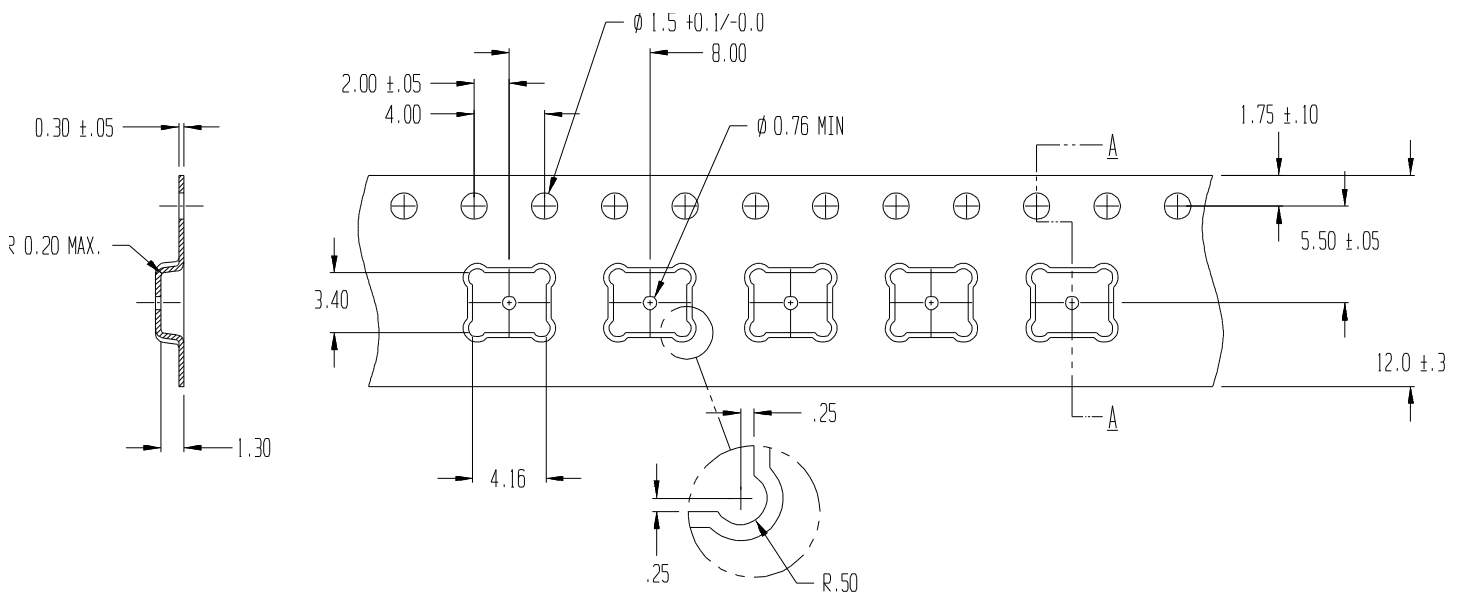


Figure 5. Tape for 4.00 × 3.00 mm Package (all dimensions in mm)

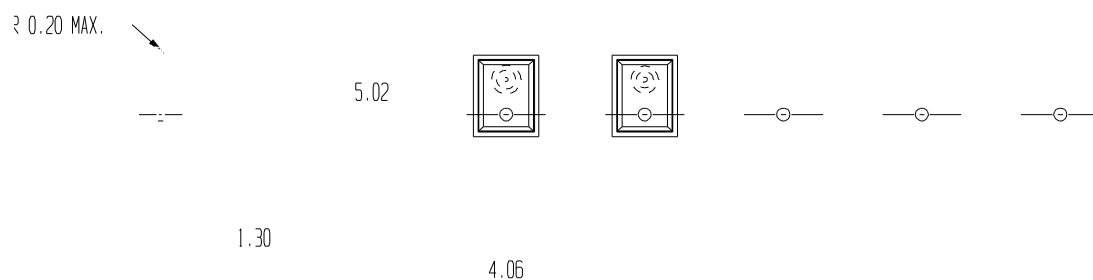


Figure 6. Tape for 4.72 x 3.76 x 1.00 mm Package (all dimensions in mm)

Figure 7. Tape for 4.72 x 3.76 x 3.50 mm Package (all dimensions in mm)

Figure 8. Tape for 3.5 x 2.65 x 0.98 mm Package (all dimensions in mm)

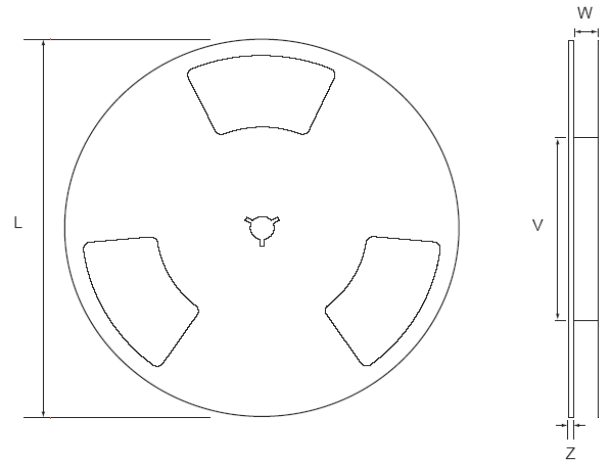


Figure 9. Reel Outline Drawing

TABLE 3. REEL DIMENSIONS

	L	V	W	Z
13" Reel	330 mm	102 mm	12.8 mm	2.3 mm
7" Reel	178 mm	68 mm	12.5 mm	3 mm

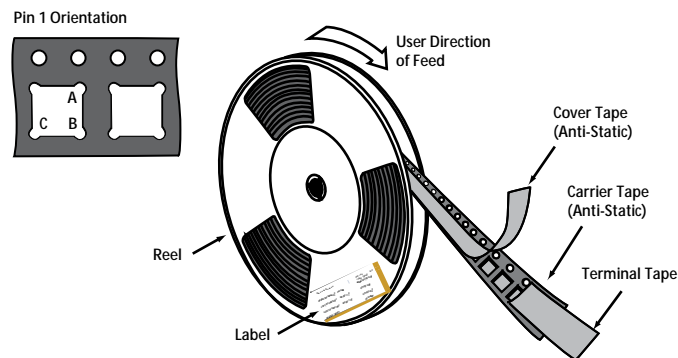


Figure 10. Tape and Reel – Package Orientation

TABLE 4. REEL SPECIFICATIONS

Body Size	Leads	Port Location	Reel Quantity		Tape Pitch (mm)	Pin #1 Orientation
			7" Reel Quantity	13" Reel Quantity		
3.35x2.5x1.0	3	Bottom	1,000	10,000	4	B
3.35x2.5x0.98	3	Bottom	1,000	10,000	4	C
3.35x2.5x0.98 (ICS-40310)	3	Bottom	1,000	10,000	4	B
3.35x2.5x0.92	3	Bottom	1,000	10,000	4	B
3.35x2.5x0.88	3	Bottom	1,000	10,000	4	B
3.5x2.65x0.98	5	Bottom	1,000	10,000	4	B
3.5x2.65x0.98	6	Top	1,000	10,000	4	A
3.5x2.65x0.98	6	Bottom	1,000	10,000	4	B
4.00x3.00x1.0	5	Bottom	1,000	5,000	8	A
4.00x3.00x1.0	7	Bottom	1,000	5,000	8	A
4.00x3.00x1.2	4	Bottom	1,000	5,000	8	C
4.72x3.76x1.0	6	Bottom	1,000	4,500	8	B
4.72x3.76x0.98	9	Bottom	1,000	4,500	8	B
4.72x3.76x3.50	6	Bottom	500	2,000	8	B

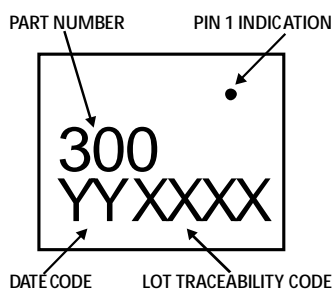


Figure 11. Example Package Marking Specification, Top View (See product data sheet for specific marking information)

REEL & PIZZA BOX LABEL

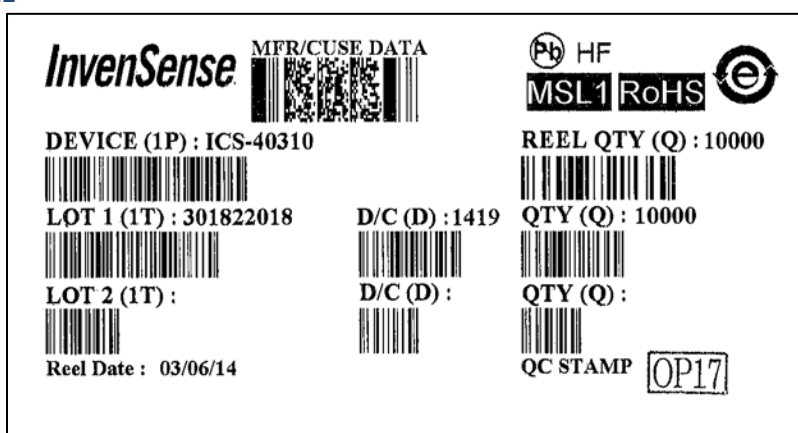


Figure 12. Barcode Label (ICS-40310 as an example)



Figure 13. Location of Label on Reel

PACKAGING

Quantity Per Reel	1,000 - 10,000
Reels per Box	1
Boxes Per Carton (max)	5
Pcs/Carton (max)	5,000 - 50,000

Caution
This bag contains
MOISTURE-SENSITIVE DEVICES

LEVEL
3

1. Calculated shelf life in sealed bag: 12 months at <40°C and <90% relative humidity (RH)

2. Peak package body temperature: 200 ±0.5 °C
If blank, see adjacent bar code label

3. After bag is opened, devices that will be subjected to reflow solder or other high temperature process must be

a. Mounted within: 100 hours of factory conditions
If blank, see adjacent bar code label
≤30°C/60% RH, or

b. Stored per J-STD-033

4. Devices require bake, before mounting, if:

a. Humidity Indicator Card reads >10% for level 2a-5a devices or >60% for level 2 devices when read at 23 ± 5°C
b. 3a or 3b are not met

5. If baking is required, refer to IPC/JEDEC J-STD-033 or
bake devices for 9 hours at 125 ± 5°C in trays etc.
bake devices for 200 hours at 40°C, 20%RH in Tape-and-Reel

Bag Seal Date: _____
If blank, see adjacent bar code label

Note: Level and body temperature defined by IPC/JEDEC J-STD-033

Figure 14. Example MSL Label

*Shipping Label**Moisture
Sensitivity
Label*

Figure 15. Moisture Sealed Reel

Figure 16. Standard ESD Caution/Fragile Label on Box



Pizza Box

Pizza Boxes Placed in Foam-Lined Shipper Box

Outer Shipper Label

Figure 17 .13" Reel Boxes and Labels



7" Box

7" Reel Box in Single Small & Standard Carton Foam-Lined Shipper Box

Outer Shipper Label

Figure 18 . 7" Reel Boxes and Labels

REPRESENTATIVE SHIPPING CARTON LABEL

E4		Delivery Name NO:	
InvenSense		405010	
From: InvenSense Taiwan Ltd. 1F,9 Prosperity 1st Road,Hsinchu Science Park, Hsinchu City,30078,Taiwan TEL: +886 3 6686999 FAX: +886 3 6686777		Ship To: AVNET INTERNIX K.K. AVNET INTERNIX K.K.,59-10, Takakura-cho,Hachioji,,Tokyo,192- 0033,JP	
SUPP PROD ID: MPU-9150			
LOT#: D3A910-J1		LOT#:	
QTY: 10273		QTY: 0	
LOT#: D3A598-J1		LOT#:	
QTY: 4727		QTY: 0	
LOT#:		LOT#:	
QTY: 0		QTY: 0	
LOT#:		LOT#:	
QTY: 0		QTY: 0	
Total Quantity/Carton:		Weight : (KG)	
15000		4.54	
Pb-free		Shipping Carton:	
MSL3 RoHS		Category (e4) HF	
1		1	
OF		Underfill	

Figure 17. Outer Shipping Carton Label (MPU-9150 as an example)

REVISION HISTORY

REVISION DATE	REVISION	DESCRIPTION
7/14/2014	1.0	Initial Release
11/17/2014	1.1	Updated Table 3
11/06/2015	1.2	Updated Table 5
12/10/2015	1.3	Updated Table 4
9/21/2016	1.4	Updated Packaging Specifications
7/12/2017	1.5	Updated Packaging Specifications

COMPLIANCE DECLARATION DISCLAIMER

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