

## MEMS Microphone Handling and Assembly Guide

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### **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°C +0°C/-5°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.

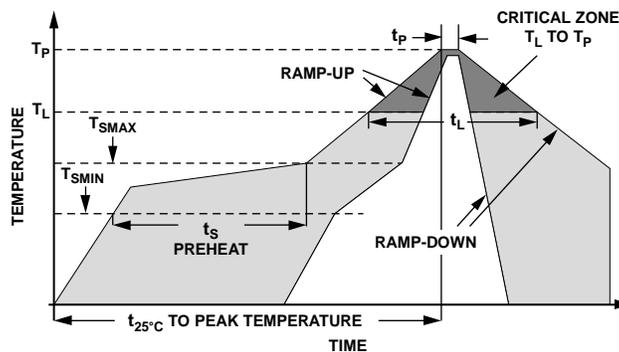


Figure 1. Recommended Soldering Profile Limits

**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 ( $t_{25^\circ C}$ ) 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.

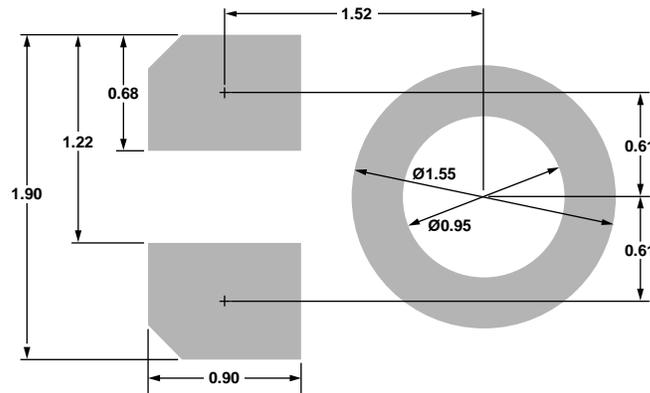
1. Place the PCB with the microphone on a soldering hot plate.
2. Heat the PCB so that the solder becomes liquidous.
3. Use fine-tipped tweezers to remove the microphone from the PCB.
4. Apply additional solder paste to pad sites using a manually operated dispensing system, such as a syringe with a small-gauge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

**CAUTION**

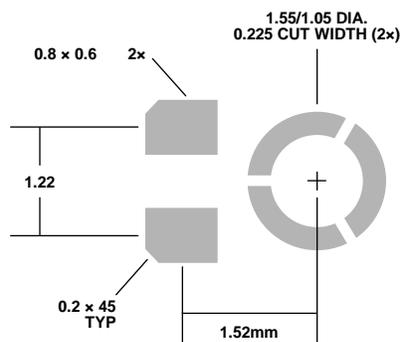
The MEMS microphone package has a port hole opening that is sensitive to solder flux. Do not use a vapor phase soldering process. The MEMS microphone can be damaged if subjected to cleaning processes. The cleaning solvents can enter through the port hole and damage the device.

**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

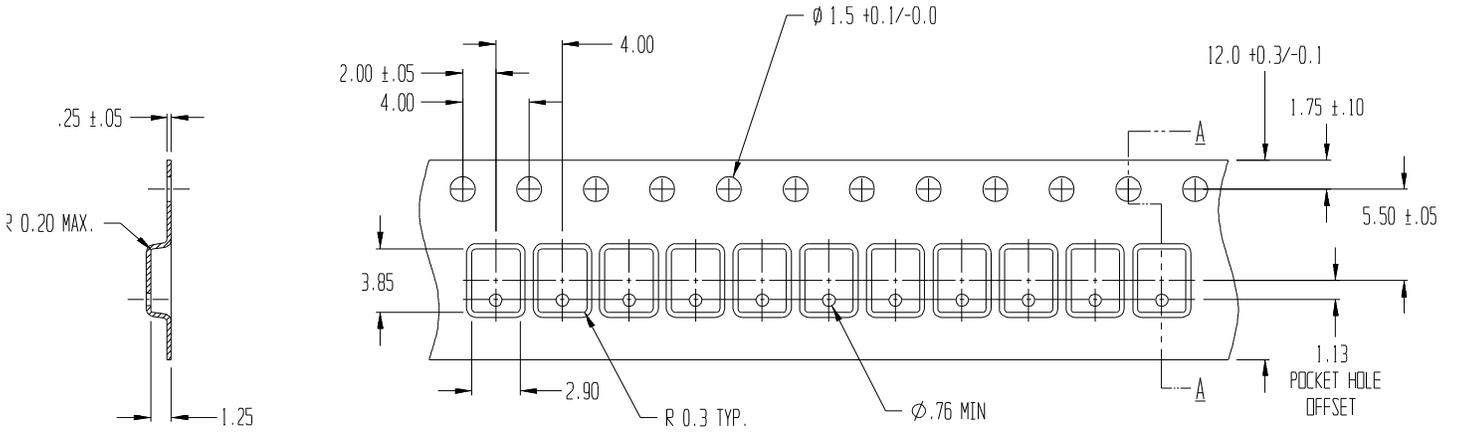
InvenSense products conform to the storage specifications of IPC/JEDEC J-STD-020D.1. All InvenSense microphones are rated at MSL1 except for the INMP521, which is rated at MSL3.

**TABLE 2. HANDLING CONDITIONS FOR DIFFERENT MSL RATINGS**

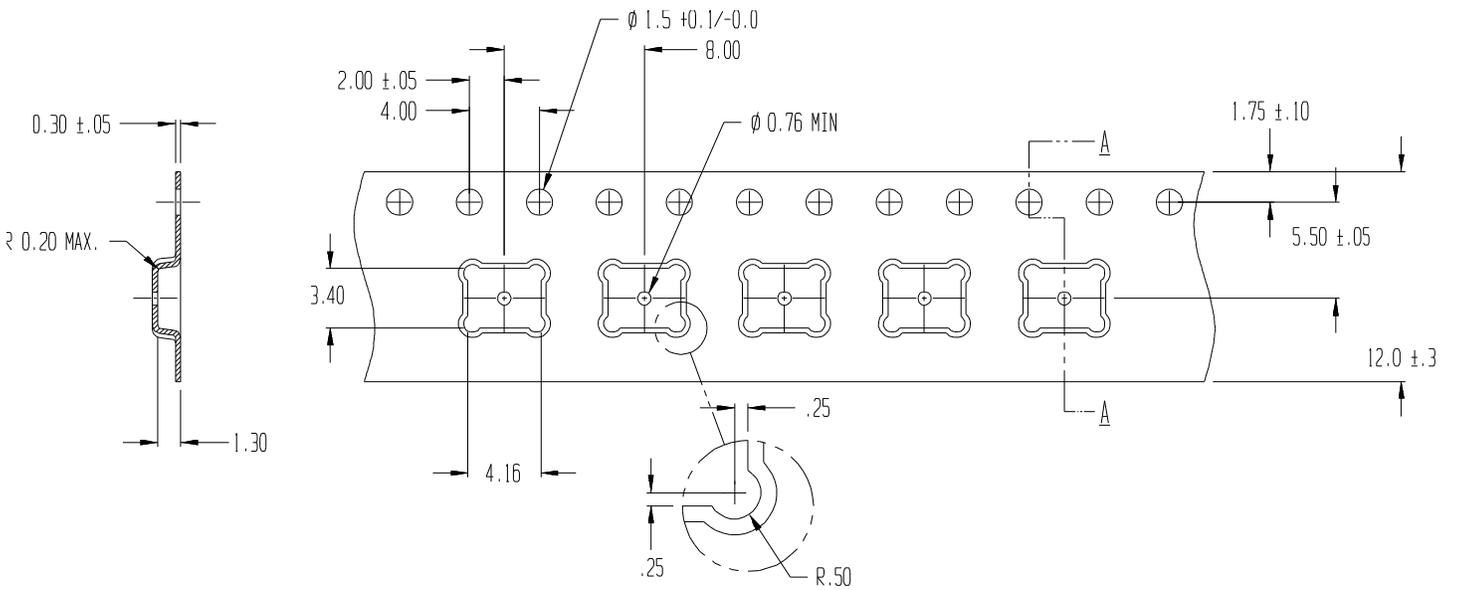
Rating	After opening moisture-sealed bag
MSL 1	Unlimited (Storage Conditions: Ambient $\leq 30^{\circ}\text{C}$ at 85%RH)
MSL 3	168 hours (Storage Conditions: Ambient $\leq 30^{\circ}\text{C}$ at 60%RH)
MSL 5	48 hours (Storage Conditions: Ambient $\leq 30^{\circ}\text{C}$ at 60%RH)

**PACKAGING SPECIFICATIONS**

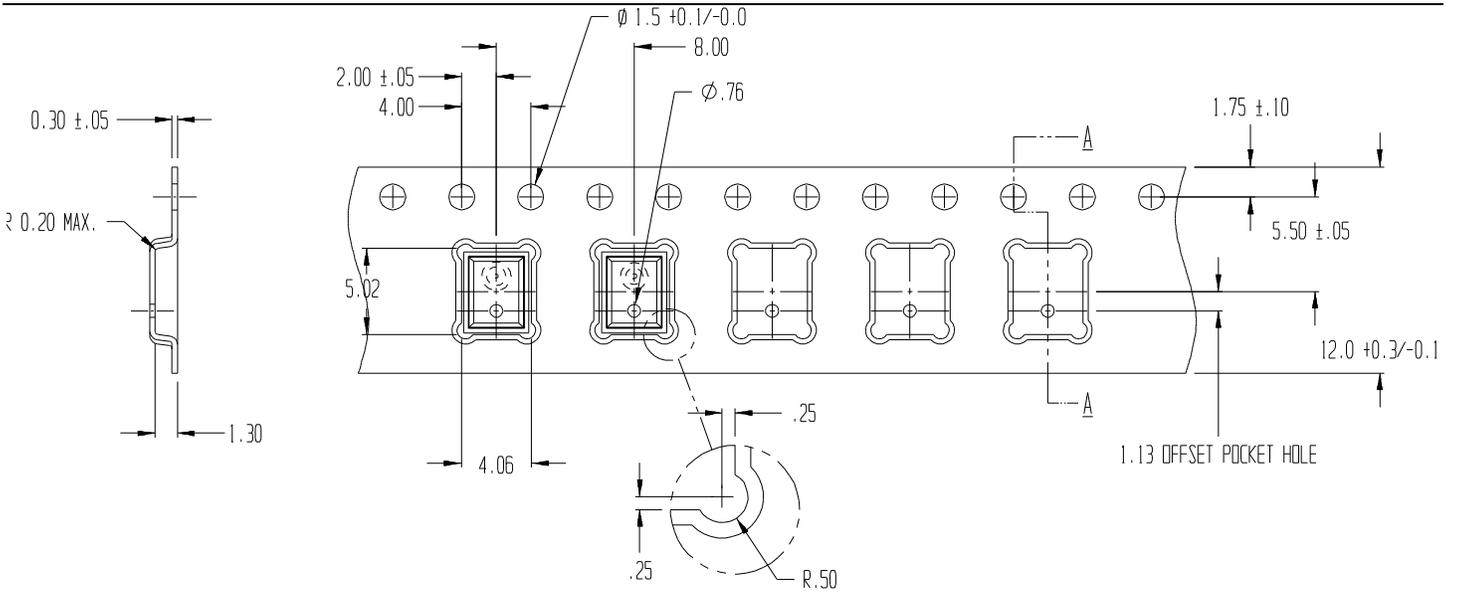
**TAPE AND REEL**



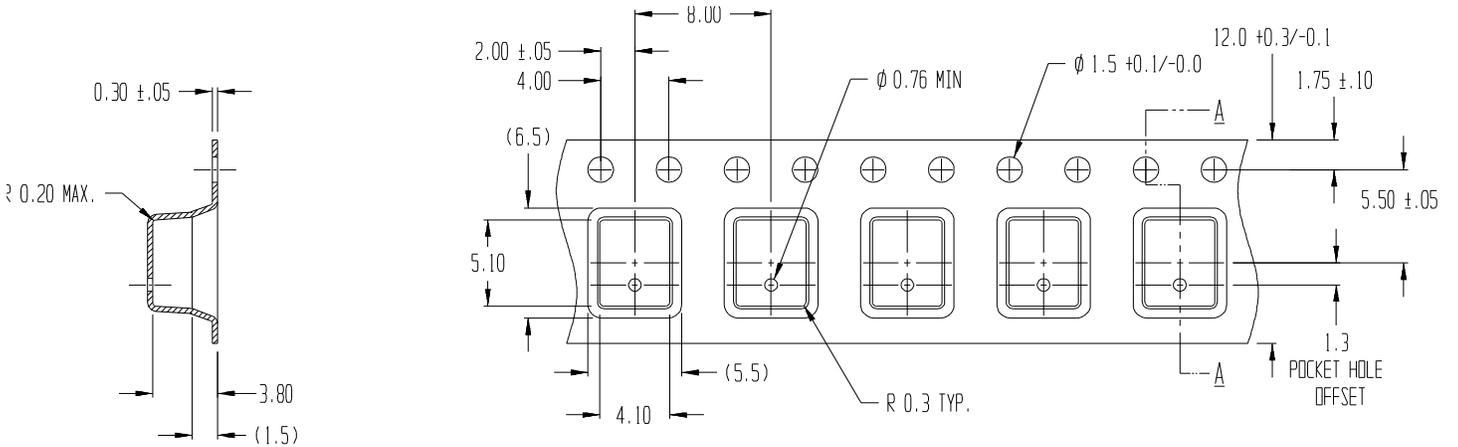
**Figure 4. Tape for 3.35 x 2.5 mm Packages (all dimensions in mm)**



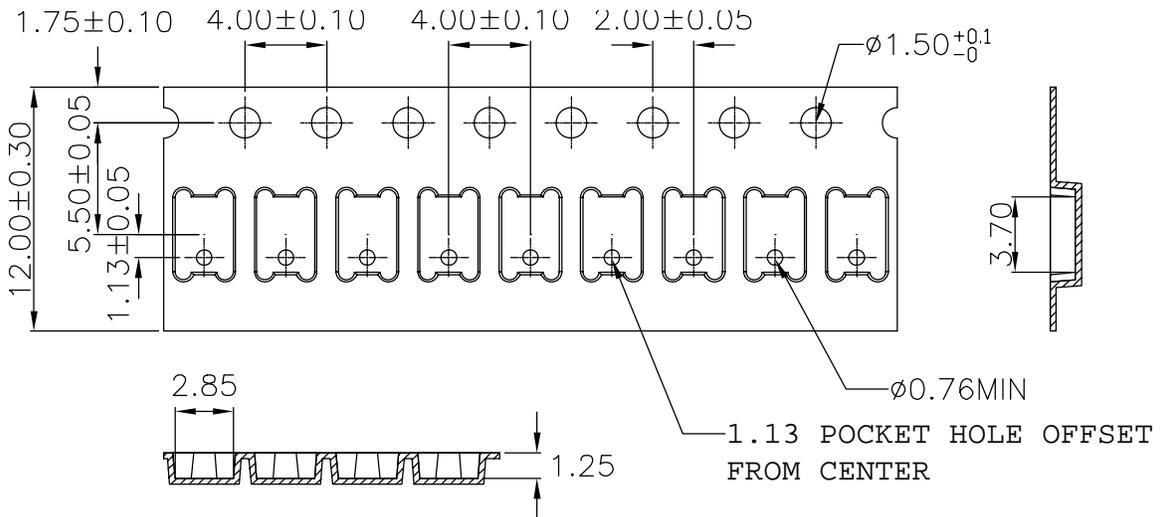
**Figure 5. Tape for 4.00 x 3.00 mm Package (all dimensions in mm)**



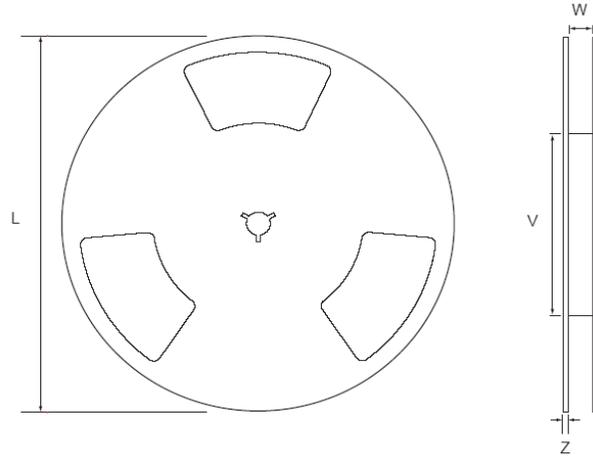
**Figure 6. Tape for 4.72 × 3.76 × 1.00 mm Package (all dimensions in mm)**



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



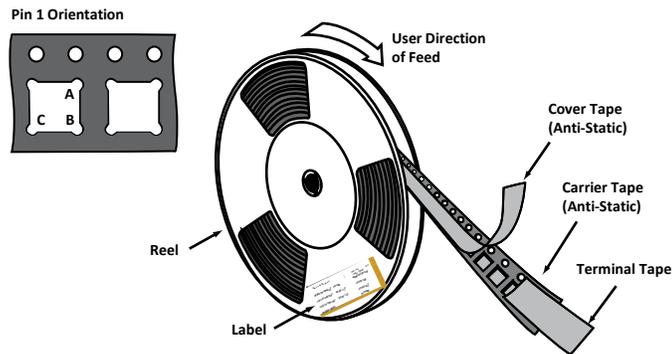
**Figure 8. Tape for 3.5 × 2.65 × 0.98 mm Package (all dimensions in mm)**



**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

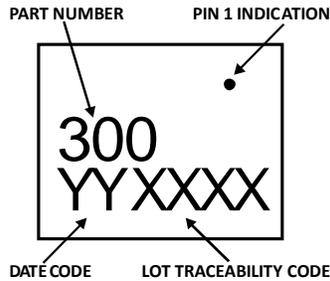


Figure 11. Example Package Marking Specification, Top View (See product data sheet for specific marking information)

**REEL & PIZZA BOX LABEL**

The label contains the following information:

- InvenSense** logo and MFR/CUSE DATA barcode.
- MSL1 RoHS and HF (High Frequency) symbols.
- DEVICE (1P) : ICS-40310
- REEL QTY (Q) : 10000
- LOT 1 (1T) : 301822018
- D/C (D) : 1419
- QTY (Q) : 10000
- LOT 2 (1T) :
- D/C (D) :
- QTY (Q) :
- Reel Date : 03/06/14
- QC STAMP: OP17

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

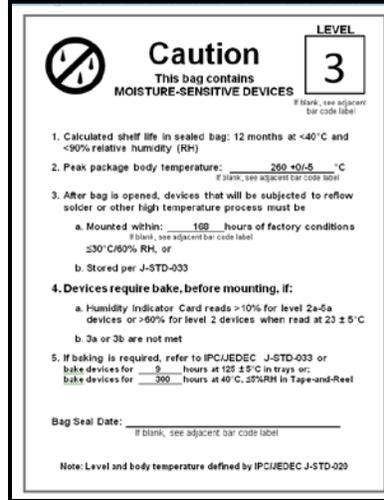


Figure 14. Example MSL Label



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

<b>E4</b>		<b>Delivery Name NO:</b>	
<b>InvenSense</b>		<b>405010</b>	
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: <b>MPU-9150</b>			
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:	Category (e4) HF
<b>MSL3</b>	<b>RoHS</b>	1	1
		OF	

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

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