

Handling and Mounting MEMS Silicon Dies

1. Introduction

The following application note is intended to describe the best methods for handling and mounting MEMS silicon dies. Merit Sensor produces all dies on 4- and 6-inch silicon wafers, which are sawn and delivered on dicing tape. The dicing tape is attached to a metal wafer frame (see figure 1) that is suitable for most automated die bonders. Any unit that is marked with a black ink dot is considered a bad unit.



Figure 1

2. Receiving and Storing MEMS Silicon Dies

All wafers assembled on dicing tape will be delivered in plastic clamshells (see figure 1), which are then inserted into an antistatic zip-lock bag. One bag can contain multiple clamshells with wafers. There will be a label (see figure 2) on each clamshell, containing the part number, purchase order number (if applicable), lot number (including wafer number), and quantity of good dies. The lot and wafer number will also be written on the dicing tape.



Figure 2

The bags should be opened only in a cleanroom and subsequently stored in an environment that is dark and dry, preferably in a nitrogen-filled cabinet. The inventory storage temperature should be between 19 and 26 °C. The storage time of diced wafers inside a proper storage environment is approximately 5 years. Storage longer than 5 years or in an environment that is uncontrolled or different than that which has been specified may result in picking problems, such as the dies sticking when they are picked and the wires not bonding due to corrosion of the aluminum bonding pads on the dies.

3. Handling MEMS Silicon Dies

All Merit Sensor dies are 100% electrically tested for bridge resistance and offset to ensure that they comply with the datasheet limits. All wafers undergo automatic optical inspection to guarantee that the dies are free from defects. The dies are RoHS compliant and in most cases consist of a silicon-glass stack that is electrostatically bonded together.

- Merit Sensor wafers are mounted, tested, diced, and delivered on a metal wafer frame. Each wafer yields approximately 600 to 6,000 pieces, depending on the product.
- Merit Sensor will also ship dies in waffle packs because for smaller volumes picking dies from waffle packs is much easier and may be necessary if the customer doesn't have die-picking equipment with ejector pins.
- The surface of silicon wafers and dies is very sensitive, so special care should be taken when handling them.

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- No cleaning of wafers and dies is necessary, but they should be opened in a cleanroom.
- Don't pick up silicon dies with tweezers. Dies should be picked up with a tool made of soft rubber containing a vacuum hole in the middle that is larger than the membrane of the dies.
- The bonding force should be less than 100 grams in order to prevent mechanical stress, which can result in an unstable, drifting offset.
- All tools should be cleaned thoroughly to prevent any residue on the bonding pads, which could lead to reliability problems.
- For gage pressure sensors, i.e. containing a hole in the bottom glass of the dies, ejector pins with 3 or 4 needles may be used to remove dies from the wafer tape.
- For absolute pressure sensors, i.e. containing no hole in the bottom glass of the dies, a single ejector needle will be sufficient.

4. Mounting MEMS Silicon Dies

- All Merit Sensor dies have been optimized for the highest output signal and long-term stability. In order to achieve the best performance (e.g., long-term drift, hysteresis, and temperature behavior), it is critical that special care be taken when mounting each die.
- Silicon dies are sensitive to mechanical stress, especially dies with full-scale pressures below 1 bar. These dies should be mounted with a soft silicone adhesive (A25 or lower) and a bond-line thickness of 50–100 μm . Special care should be taken to prevent the adhesive from climbing up the outside or inside walls of the dies, as this could lead to unstable output.
- Die bonding with hard silicone or epoxy will typically result in an unstable offset value and high TCO (temperature coefficient offset).

5. Connecting Wires to MEMS Silicon Dies

- The bond pads on each die are at least 100 x 100 μm . The pad material is aluminum with a thickness of 1–1.4 μm .
- Wire bonding can be done with aluminum or gold wire.
- The wire bonds can be protected with a soft ion-free silicone gel that has a viscosity of <1000 cps and no hardness. The gel can have a significant impact on the performance of the dies; therefore, special care should be taken when selecting a gel.
- A drop of gel can be applied to the surface of the dies to protect the bond pads from corrosion. If further humidity protection is required, then the entire area around a die, including bonding wires, can be covered.
- For gage pressure sensors, on which pressure is applied from the bottom/back side of the die, the top side of the die can be protected with gel to avoid corrosion of the aluminum bonding pads.

6. Disclaimer Notice

Merit Sensor produces high-quality products that perform within the parameters of their applicable data sheet. Typical performance values for pressure and temperature are not tested 100%, but they have been validated during qualification. Merit Sensor cannot guarantee that dies will function properly after they have been mounted and processed by the customer. It is the responsibility of the customer to test and qualify the functionality of any MEMS silicon die in the final package. The customer is responsible for knowing how to handle MEMS silicon dies. Merit Sensor assumes no liability for consequential damages that may result in yield loss or field failures in a customer's final application.

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