

# MEMS Technology

MEMS are micron-size devices that can sense or manipulate the physical world. MEMS are typically created on silicon wafers, but can also use other substrate types as well. Due to size, tens of thousands of these devices can be fabricated on a single wafer.



Courtesy Sandia National Laboratories SUMMIT™ Technologies [www.mems.sandia.gov](http://www.mems.sandia.gov)

Microelectromechanical Systems (MEMS) are micron-size devices that can sense or manipulate the physical world. MEMS are created using micromachining processes, similar to those used to produce integrated circuit (IC) devices. This allows a two or three-dimensional mechanical system to be created in the same small area typical of an IC device. Because the fab process is similar to that of IC fabrication, MEMS are most typically created on silicon wafers but can also employ other substrate types as well. Due to their size, tens of thousands of these devices can be fabricated on a single wafer.

## MEMS PACKAGING CONSIDERATIONS

Amkor Technology is the world leader in microelectronic packaging technologies and the world's largest outsource provider of MEMS and MOEMS.

### GENERAL REQUIREMENTS

- ▶ Controlling stresses to the MEMS structure
- ▶ Allowing the stimuli to reach the MEMS structure
- ▶ Protecting the MEMS and ASIC devices

### CONSUMER MARKET

- ▶ Quick turnaround time
- ▶ Highly reusable packaging
- ▶ Miniaturization roadmap

### AUTOMOTIVE MARKET

- ▶ More stringent device package protection
- ▶ Customized requirements

## MEMS Applications

Amkor Technology is the world's leader in microelectronic packaging technologies and the world's largest outsource provider of MEMS and Micro Optical Electronic Mechanical Systems (MOEMS).

| MEMS/Sensor    | Consumer Devices | Automotive | Health & Fitness | Home/Industrial |
|----------------|------------------|------------|------------------|-----------------|
| Accelerometer  | ✓                | ✓          | ✓                | ✓               |
| Biosensors     |                  |            | ✓                |                 |
| Chemical/Gas   | ✓                |            |                  | ✓               |
| Fingerprint    | ✓                | ✓          |                  |                 |
| Gyroscope      | ✓                | ✓          | ✓                | ✓               |
| Humidity       | ✓                | ✓          |                  | ✓               |
| Inertial (IMU) | ✓                | ✓          | ✓                |                 |
| IR             | ✓                | ✓          | ✓                | ✓               |
| Light/Optical  | ✓                | ✓          | ✓                | ✓               |
| Magnetometer   | ✓                | ✓          |                  |                 |
| Microphone     | ✓                | ✓          | ✓                | ✓               |
| Pressure       | ✓                | ✓          | ✓                |                 |
| Temperature    | ✓                | ✓          | ✓                | ✓               |

## Amkor's Value Proposition

### MEMS Manufacturing

- ▶ Standard platforms = Faster development
  - ▷ Faster introduction of new products
  - ▷ Lower development cost
- ▶ Amkor experience
  - ▷ Dedicated MEMS team
  - ▷ Constantly updating the MEMS toolbox with investments in new equipment and materials and leveraging other core technologies like TSV and Cu Pillar
  - ▷ In-house test development capability



# MEMS Technology

## Material Characterization

DMA, DSC, TGA, TMA, thermo moiré, FTIR, interferometer, hardness, ARES, diffusivity, solubility and more.

## Modeling And Simulation

Complete electrical and thermo-mechanical capabilities (mechanical, thermal, electrical, EMI/RFI modeling).

## Package And Board Level Reliability

Amkor offers a full range of reliability test capabilities in multiple locations.

Amkor presently conducts MEMS/sensor-related activities at the following strategic manufacturing locations:

- ▶ Philippines (ATP)
- ▶ Korea (ATK)
- ▶ China (ATC)
- ▶ Japan (ATJ)

## Cavity MEMS Packages

| Open Tool Available (Sample Builds) | Lead Count | Body Width (mm) | Body Length (mm) | Body Thickness (mm) | Pkg Type              | Lid Type     | Die Qty    | Interconnect | Factory | POD Dwg  | Unit Dwg |
|-------------------------------------|------------|-----------------|------------------|---------------------|-----------------------|--------------|------------|--------------|---------|----------|----------|
|                                     | 8          | 2               | 2                | 0.8                 | Cavity LGA            | Metal        | Multi-die  | WB           | P3      | TBD      | -        |
|                                     | 8          | 4               | 4                | 0.9                 | Cavity LGA            | Metal        | Multi-die  | WB           | P3      | 643113PO | -        |
|                                     | 8          | 5               | 5                | 1                   | Cavity LGA            | Metal        | Multi-die  | WB           | P3      | TBD      | -        |
|                                     | 8          | 7               | 7                | 1                   | Cavity LGA            | Metal        | Multi-die  | WB           | P3      | 647876PO | 647874UD |
|                                     | 8          | 4               | 3                | 1                   | Cavity LGA            | L2L          | Multi-die  | WB           | P3      | 698505PO | 698275UD |
|                                     | 8          | 5               | 2                | 1                   | Molded Cavity LGA/BGA | Glass/Filter | Single Die | WB           | C3      | TBD      | -        |
|                                     | 22         | 6.8             | 4.9              | 1.2                 | Molded Cavity LGA/BGA | Glass/Filter | Single Die | WB           | C3      | TBD      | -        |
|                                     | 20         | 6               | 6                | 1.9                 | Cavity LF             | Polymer      | Multi-Die  | WB           | P3      | 610182PO | 640993UD |
|                                     | 18         | 15              | 25               | 0.45                | Molded Cavity LGA/BGA | MicroLens    | Single Die | WB           | C3      | TBD      | -        |

## MEMS/Sensor Package Standards

| Package Type         | Overmolded | Exposed Die Surface | Cavity Package | Molded Cavity Package |
|----------------------|------------|---------------------|----------------|-----------------------|
| Leadframe SOIC/MLF®  |            |                     |                |                       |
| ChipArray® LGA/FPBGA |            |                     |                |                       |



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