SMART MICROSYSTEMS

Your Microelectronic Package Assembly Solution for MEMS Sensors
Why MEMS is Important
Growing Industry Segments
About SMART Microsystems
What We Do
How We Do It
Working with SMART
Why MEMS is Important
MEMS Sensors Market Growth

**CAGR 13.8% Over 2016-2021**

- Large growth driven by Consumer and Automotive applications
- High growth seen in Environmental, RF, and Optical MEMS
- MEMS pressure sensors dominant in Aerospace, Automotive, Consumer, and Medical
Market Drivers

Opportunities for New Applications

- Big influences from IoT, Wearables, and Automotive
- Existing infrastructure - Connectivity, Software, Power, Data Management
- Evolution of the economy - SMART Connected Products*

MEMS Sensors Packaging Challenge

Stimulus Delivery

- Environment isolation/exposure, mechanical stress, thermal effects
- Components, mechanical interfaces, and electrical interconnects
- Material selection based on application
Growing Industry Segments
Aerospace

- Miniaturization driving applications for MEMS sensors
- Reduction of size, weight, and power consumption
- Requirement for high reliability
Industrial

- More data from MEMS sensors drives performance and efficiency
- Proactive maintenance of industrial systems reduces downtime
- Requirement for high reliability with power and communication infrastructure
Growing Industry Segments

Medical

- Opportunities for MEMS sensors in clinical and consumer markets
- Low cost, light (no) weight, and fast response time
- Non-invasive, real time measurements for improved outcomes
About SMART Microsystems
SMART Facilities and Location

MEMS Sensors Microelectronic Assembly

- Launched in 2011
- Located in Elyria, Ohio USA
- Facilities - 15,000 sq ft with 5,000 sq ft ISO 5 and ISO 6 cleanrooms
- Engineering and Manufacturing Services
The SMART Team

Committed to Immediate and Long Term Value to Customers

- Technical merit, high quality, and customer satisfaction
- Significant experience in product development
- Management team with proven track record
The SMART Advantage

Lowest Overall Development Time and Cost

- **Proven** New Product Development Strategies
  - Test Early, Test Often
  - Concurrent Engineering
- **Focus** on niche applications
- **Flexibility** for non-standard/custom designs
What We Do
TO Header Assembly

**Applications** – optical sensing, imaging/illumination, pressure sensing, environmental sensing, industrial chemical sensing

**Process Capabilities**
- **Die Attach** – epoxy, solder, sinter, thermocompression
- **Wire Bond** – gold ball and wedge
- **Lid Attach** – epoxy, solder
Chip on Board / Chip on Flex

Applications – flow actuators, optical devices, pressure sensors, lab on a chip

Process Capabilities
- **Die Attach** – epoxy, tape
- **Wire Bond** – gold ball/wedge, aluminum wedge
- **Encapsulation** – dispense, parylene, lid attach
Open Cavity QFN and Ceramic Package

**Applications** – image sensors, chemical sensors, resonators, inertial sensors, lab on a chip

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Custom Package Assembly

**Applications** – optical sensors, pressure sensors, chemical sensors

**Process Capabilities**
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How We Do It
Die Attach

Auto Die Attach – *Datacon Evo 2200 Plus*
- Epoxy die attach, flip chip, sintering, eutectic attach, multi-chip module
- X/Y placement accuracy: ±7μm

Vacuum Solder Reflow – *SST 5100*
- Hermetic package sealing
- Vacuum minimum 50mTorr
- Operating temperature range of 100 to 500°C

Manual Die Attach – *Tresky T-3002FC3*
- Epoxy die attach, thermocompression, flip chip
Wire Bonding

**Gold Ball Bonding** – *K&S iConn*
- Ball Bonding and Stud Bumping
- Wire diameters: 0.6 to 2.0 mil

**Fine Gauge Wedge Bonding** – *Hesse BJ820*
- Wire diameters: 0.7 to 2.0 mil
- Ribbon: 0.25x1.4 mil to 1x10 mil
- Wire and ribbon materials: aluminum, gold

**Heavy Gauge Wedge Bonding** – *Hesse BK939*
- Wire diameters: 4 to 20 mil
- Ribbon: 3x30 mil to 16x80 mil
- Wire and ribbon materials: aluminum
Encapsulation

Dispense
- Dam and fill, glob top, potting
- Epoxies, heat cures, humidity cures, thixotropic adhesives
- Time/pressure dispense, auger dispense, and jetted dispense

Lid Seal
- Solder, epoxy, tape
- Hermetic and non-hermetic

Parylene
- Type C and Type N
Environmental Testing

- Thermal/Humidity Cycling
- Highly Accelerated Stress Test (HAST)
- Thermal Shock
- High/Low Temperature Storage
- Accelerated SUV Radiation Test
- Vibration
Failure Analysis

- 3D X-ray
- Scanning Electron Microscope
- Emission Dispersion Spectroscopy
- Scanning Acoustic Microscopy
- Interferometer Surface Profiling
Working with SMART
Proof of Concept and Prototypes

- Trials to test new materials and processes
- Process development for new products
- Build and deliver samples
Environmental Life Testing

- Early testing of new materials and processes
- Prototype testing
- Product qualification
Manufacturing

- Microelectronic sub-assemblies
  - Primarily MEMS sensors
- Annual volumes 100 - 100k units
- Custom US supplier
SMART Qualifications
SMART Quality System

ISO 9001:2008 Certification
- On-time delivery, yield, customer satisfaction

Quality Control
- Coordinate measurement system
- Shear and pull testing
### Proven Track Record

- Provided over 50 customers with very first MEMS sensor prototypes.
- One project went from design to working prototypes in 90 days.
- Successfully brought several new development programs to production readiness.

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**Prototyping**
- Medical Pressure Sensor
- Fluidic Chemical Sensor
- High Temp IC Packaging

**Life Test**
- Specialty Materials
- Films & Coating Materials
- Shelf Life Test

**Manufacturing**
- Optical Industrial Sensor
- Lab on a Chip
- Aerospace Pressure Sensor
Summary

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We’re Conveniently Located. Located in Northeast Ohio, SMART customers benefit from one of the very few highly experienced MEMS sensors package assembly suppliers in North America.
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