

MEMS PRESSURE SENSOR MARKET AND TECHNOLOGIES 2018

Market & Technology report - May 2018

Automotive and consumer applications are propelling the MEMS pressure sensor business to new heights.

WHAT'S NEW

- Updated market forecast for 29 applications
- New applications: pedestrian protection, wearables, drones, electronic cigarettes, transportation, smart inhalers and avionic hydraulics
- Main specifications and trends for each application
- In depth analysis of automotive applications, especially tire pressure monitoring systems (TPMS) with key products reverse engineered
- In depth analysis of consumer applications with key products reverse engineered
- In depth analysis of key players by market and by piezoresistive or capacitive technology, and expected evolution
- Analysis of past mergers and acquisitions and potential future targets
- New market forecast broken down into absolute, gauge and differential pressure sensor categories
- Competitive positioning of MEMS technology against other technologies
- Competitive positioning of piezoresistive against capacitive MEMS
- Analysis of main technical trends: miniaturization and monolithic approaches

KEY FEATURES OF THE REPORT

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- Market forecast for 2017-2023 in volume and value; broken down by market, spanning automotive, consumer, industrial, medical, avionics and high-end applications; broken down across 29 different applications; and broken down into absolute, gauge and differential pressure sensor categories
- Competitive landscape with player market shares by technology and market, supply chain analysis and market dynamics
- Pressure sensor applications, market drivers, main trends and key players
- Technology descriptions and comparisons, main trends and main players

AUTOMOTIVE AND CONSUMER APPLICATIONS WILL CONTINUE TO DRIVE THE PRESSURE SENSOR BUSINESS

The automotive industry is the oldest and the biggest market for MEMS pressure sensors. Powertrain applications represent more than 50% of the business, followed by safety, with tire pressure management systems (TPMS) being the biggest single automotive application. Driven by CO2 emission reduction and automation, pressure sensors will increasingly be used in the next five years, especially in China, whose regulations will require pressure sensors for several applications. These include TPMS, diesel and gasoline particle filters (DPF, GPF) and fuel tank evaporation (EVAP).

The consumer market is now the second largest pressure sensor business, thanks to recent rapid adoption in high-end smartphones and tablets. This will further extend to Android mid-to-low value smartphones, driven by new use cases, such as indoor and outdoor navigation. Lower sensor costs and better accuracy and power also enable new applications to grow, such as

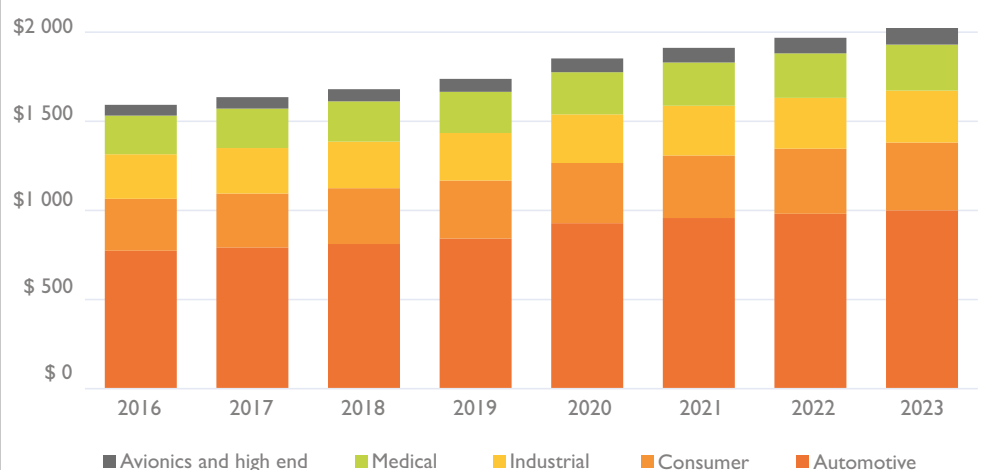
wearables, electronic cigarettes, drones, and smart homes.

Avionics and high-end applications are still niche markets, but exhibit the fastest market growth thanks to the dynamic aircraft market and MEMS taking over from traditional technologies.

The medical and industrial markets are growing at a moderate rate because there is no significant change in term of applications, with one exception. New medical smart inhalers are in between the medical and consumer markets, and pave the way for many future medical consumer Internet of Things (IoT) applications.

Overall, the MEMS pressure sensor market will grow by 3.8% per year, reaching a value of \$2B in 2023. The report identifies the key driving forces and restraints for each pressure sensor market and application, and provides accurate market value and volume forecasts.

MEMS pressure sensor market forecast, broken down by market



(Yole Développement, May 2018)

THE COMPETITIVE LANDSCAPE VARIES BETWEEN THE AUTOMOTIVE, CONSUMER, MEDICAL, INDUSTRIAL, AVIONICS AND HIGH END MARKETS

The competitive landscape varies greatly with the type of market addressed.

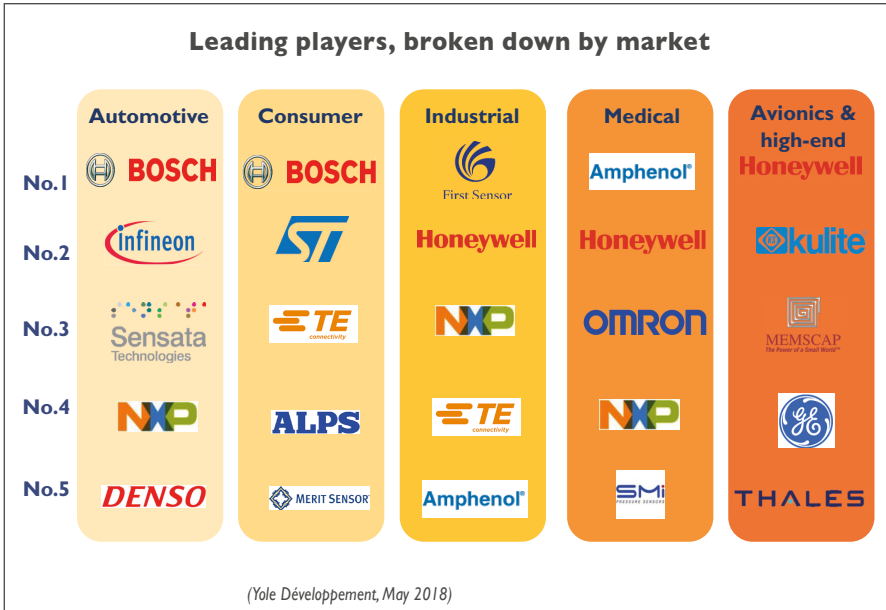
- In both the high-volume automotive and consumer markets, Bosch is clearly the

dominant leader. This is a unique position. Bosch has succeeded in leveraging its automotive product leadership to become leader in the newer consumer market.

Bosch has aggregated both markets' production volume to reduce cost, and further increase its competitive advantage. Other players like Infineon, Sensata, Denso and Melexis are mainly focused on automotive, while ST Microelectronic and Alps serve the consumer

market. Only TE Connectivity and NXP also have multimarket presence. The key players are large groups active in various MEMS sensors, with inertial, pressure and gas sensor devices. Vertical integration is usual in automotive at companies like Bosch, Denso and Sensata, but not in consumer, because systems are smaller and thus there is no need for tier one component suppliers.

Leading players, broken down by market



- The medium-to-low-volume medical, industrial, avionics and high-end markets all have many of the same key players. They include Honeywell, Amphenol, NXP, TE Connectivity, Omron, First Sensor, Merit, Elmos SMI, and TDK. These companies grow their business by targeting multiple markets, and by making added-value modules. There are also pure avionics and high-end market players, such as Kulite or Memscap.

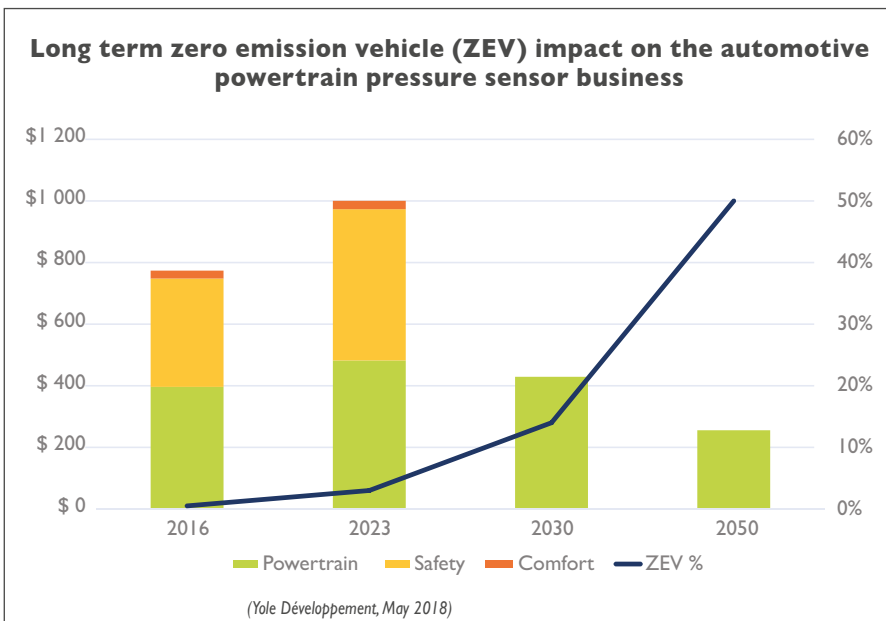
Mergers and acquisitions (M&A) between Amphenol and GE, Sensata, Schrader and CST, TDK and Invensense, and Qualcomm, NXP and Freescale all included pressure sensor activities, and activity has therefore been concentrated. The budget for future acquisitions will probably exceed \$100M. The report lists future possible targets, and ranks them to help M&A decision makers.

TECHNICAL TRENDS: AUTOMOTIVE ELECTRIFICATION WILL TRANSFORM THE PRESSURE SENSOR BUSINESS

MEMS pressure sensor technologies are now quite mature, and are basically segmented into piezoresistive and capacitive categories. These

two technologies are not hugely different. Today piezoresistive is clearly leading in terms of market share, and that will continue. We don't expect big technical breakthroughs, mainly incremental improvements, with miniaturization as important as in all semiconductor products.

Long term zero emission vehicle (ZEV) impact on the automotive powertrain pressure sensor business



We expect bigger changes at the system level, especially in automotive, which has been shaken by electrification and automation. Electrification is positive for pressure sensors when it is deployed in hybrid vehicles (HEVs) that have combustion engines that use many pressure sensors. But zero emission vehicles (ZEVs), which includes pure battery vehicles (BEVs) and fuel cell vehicles (FCVs), eliminate the combustion engine, and with it the demand for powertrain sensors. With powertrain sensors representing 51% of the automotive MEMS pressure sensor business, leading powertrain pressure sensor makers like Bosch, Infineon, or Denso must be worried about their future business. However, the transition will take more than a decade. This report will help readers find new, alternative markets.

COMPANIES CITED IN THE REPORT (non exhaustive list)

Alps, Amphenol, Bosch, CFSensor, Continental, Delphi, Denso, Elmos SMI, First Sensor, GE Druck, Honeywell, Infineon, Invensense, Keller, Kistler, Kulite, Meggit, Melexis, Memscap, MEMSensing Microsystems, Merit, MT microsystem, Murata, Murata, Nano-MEMS, NXP, Omron, Panasonic, Rohm, Schraeder, Sensata, Sensirion, ShuangQiao Sensor, ST Microelectronics, TDK, TE Connectivity, Thales, Xfab...

TABLE OF CONTENTS (complete content on i-Micronews.com)

| | | |
|--|---|------------|
| <u>Table of contents</u> | > Electrification's impact on powertrain business | |
| <u>Glossary</u> | > Players' market shares and supply chain analysis | |
| <u>Companies cited in this report</u> | | |
| <u>Definitions</u> | Consumer market | 97 |
| <u>Market research scope and methodology</u> | > Similar content to automotive | |
| <u>Executive summary</u> | Industrial market | 118 |
| <u>Global market forecast</u> | > Similar content to automotive | |
| > Market forecast by market: automotive, consumer, industrial, medical and avionics and high-end | Medical market | 129 |
| | > Similar content to automotive | |
| <u>Application overviews</u> | Avionics and high end market | 143 |
| > Growth, pressure range, type of sensor used | > Similar content to automotive | |
| > Market forecast by type of sensors | MEMS pressure sensor technologies | 154 |
| <u>Competitive landscape</u> | > History of MEMS pressure sensors | |
| > MEMS ranking and global market share | > Position of main pressure sensor technologies | |
| > Player positions by market | > Pressure range by application | |
| > Geographical localization | > Description of the main pressure sensor technologies | |
| > Analysis of the value and supply chain | > Position of piezoresistive vs capacitive MEMS | |
| > M&A and potential acquisitions | > Player adoption of piezoresistive and capacitive MEMS | |
| > Focus on China | > Cost breakdown | |
| <u>Automotive market</u> | > Main technical trends | |
| > Market segmentation and market forecast by application and ASP | > Technological roadmap | |
| > Application descriptions and main trends | General conclusions | 176 |



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OBJECTIVES OF THE REPORT

- To give a detailed analysis of all MEMS pressure sensor applications
 - Application description, sensor function, competing technologies, main market drivers and trends
- To provide market data on key pressure sensors market metrics and dynamics
 - Pressure sensor sales in volume and value by market, by application, by sensor type, and technology
 - Players market share globally and by market
- To provide key technical insight on main pressure technologies and main technological trends
 - Description of the main pressure sensor technologies
 - Reverse engineering trends for tire pressure monitoring systems (TPMS) and consumer applications
 - Technological landscape and trends for piezoresistive and capacitive MEMS technologies
- To provide an in-depth understanding of pressure sensor value chain, infrastructure and players
 - Who are the key pressure sensor players, including integrated device manufacturers, module makers and vertically integrated players, and what is their market and technological position?
 - More generally, who are the key suppliers to watch and how will the pressure sensor market evolve?
 - What are the potential targets for mergers and acquisitions?

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ASSOCIATED REPORT

MEMS Pressure Sensor Comparison 2018 - Structural, Process and Cost Report by System Plus Consulting

Structure and costing comparison of 34 MEMS pressure sensors from 18 different manufacturers in consumer, automotive and industrial applications.

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