

A brave new MEMS world: a \$18.2B market by 2026¹

The MEMS market will grow due to new opportunities in audio for microphones, microspeakers and inertial MEMS, AR/VR for optical MEMS, and other emerging applications.

OUTLINE:

- Market forecasts and trends:
The MEMS market is expected to reach US\$18.2 billion by 2026, at ~7% CAGR²₂₀₋₂₆.
Traditional MEMS devices in big markets will keep growing but at a slow rate.
The devices to watch would be microphones, inertial and optical MEMS.
The MEMS revenues are mainly driven by the consumer market with about 60% of the global MEMS revenue.
- Technology trends:
MEMS sensors & actuators were always concerned by size reduction, cost reduction and performance increase.
The trend is now to move to a more system like level approach, where heterogeneous integration is key.
Aim: increase the system level performance, while increasing accuracy and reducing cost.
- Supply chain:
MEMS players (IDMs and fabless/fablite) grew by 2.5% in 2020, totaling US\$12.1 billion.
The top MEMS players are now Bosch, Broadcom, Qorvo, STMicroelectronics, Texas Instruments, Goermicro (Goertek), HP, Knowles, TDK and Infineon.
A point of vigilance for MEMS players that have pressure sensors business in automotive, is the decline in ICE³ vehicles... See the article *Will electrification mean the end of the road for automotive MEMS pressure sensors?* on [i-Micronews](#).
MEMS sensor makers are trying to get out of the commoditization cycle and move up the value chain.
There is clearly a path being formed towards applications combining MEMS sensors with AI⁴//ML⁵/DL⁶ on the edge (or the cloud).

¹ Extracted from: [Status of the MEMS Industry 2021 report](#), Yole Développement, 2021

² CAGR: Compound Annual Growth Rate

³ ICE: Internal Combustion Engine

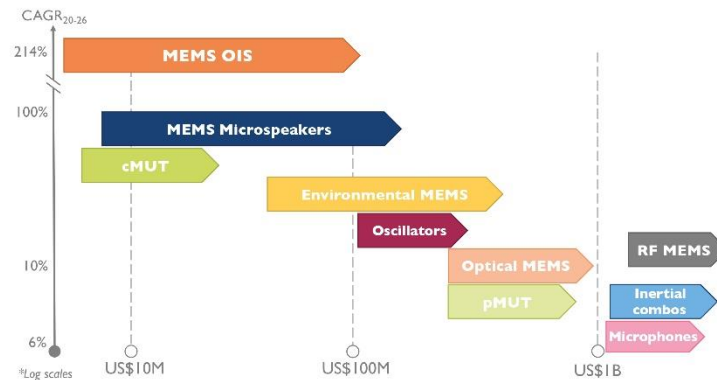
⁴ AI: Artificial Intelligence

⁵ ML: Machine Learning

⁶ DL: Deep Learning

2020-2026 MEMS industry best growth opportunities: revenues vs. CAGR*

(Source: Status of the MEMS Industry 2021 report, Yole Développement, 2021)



“Last year when COVID-19 erupted, the effects on various industries were felt immediately, which in turn had an after-effect on the MEMS business. But the crisis did not impact all end-markets the same way.” asserts **Jérôme Mouly, Team Lead Analyst, Sensing & Actuating at Yole Développement (Yole)**. He adds: “The MEMS market relies heavily on consumer applications, which are 62% of the total market, and the automotive industry, which is 16% of the total market. We therefore expected that last year the MEMS market would suffer due to COVID-19’s negative effects on end-system shipments of smartphones and cars. But this was not the case. MEMS sensor sales recovered during H2 2020”.

Manufacturers resumed refilling their inventories after signs of stabilization and recovery in key end markets. In fact, the strong demand for consumer MEMS has completely offset the automotive industry slow-down. Therefore, the MEMS market was worth almost US\$12.1 billion in 2020, up more than 2% from the year earlier.

After a weak 2019 and 2020, Yole’s analysts expect the market to grow by 11% in 2021, reaching US\$13.4 billion. After that, high-single digit growth will increase annual MEMS revenue to US\$18.2 billion by 2026.

In this context, Yole investigates disruptive technologies and related markets in depth, to point out the latest innovations and underline the business opportunities.

Released today, the [Status of the MEMS Industry 2021 report](#) updates 2020’s volumes, ASP⁷s and market sizes. It provides an overview of the best future growth opportunities for MEMS and explores the ecosystem development product-wise and funding-wise and details the main stakeholders involved. This study also summarizes the status of the 2021 MEMS industry in a thorough manner, taking into account the trends for each application separately.

⁷ ASP: Average Selling Price

As analyzed by Yole's team in the new [Status of the MEMS Industry 2021 report](#), this promised growth could be delivered by new emerging technologies and opportunities, with a few notable ones such as:

- Microphones and inertial MEMS in wearables and particularly TWS⁸ earbuds. This is driven by the need for better sound capture using microphones and VAD⁹, noise reduction with accelerometers for voice detection and bone conduction. 3D Audio is being pushed forward by Apple and will probably jump to Android devices, causing a surge in demand for IMUs¹⁰.
- Gas sensors and environmental combos, integrated in wearables or in automotive in-cabin air monitoring. These help monitor indoor and outdoor air quality around users, as they become more concerned about the air they breathe, and especially due to COVID-19.
- Optical MEMS for LiDAR¹¹ and AR/VR¹². Revenue in this sector might still be weak in five years' time. However, opportunities lie beyond this horizon, as the ADAS/AV¹³ and AR/VR markets further develop.
- PMUT¹⁴ devices, which are used in ultrasonic fingerprinting. PMUTs are also used as a replacement for physical buttons and haptics in smartphones and cars. CMUT¹⁵ devices are also very promising for the consumerization of low-cost ultrasound imaging, close to the PoC¹⁶.
- MEMS microspeakers, which should show their advantages in TWS in-ear designs first, replacing older electrodynamic or balanced armature speakers.
- MEMS-based sensor-shift OIS¹⁷. This which could replace the flexible PCB¹⁸-based sensor shift used for the first time in the iPhone 12 Pro's camera module. It may also enter other camera modules in other handsets or consumer devices.

According to **Dimitrios Damianos, Senior Technology & Market Analyst at Yole**: *“The pandemic, global lockdowns and the US-China trade war heavily impacted the supply chain of the semiconductor industry. A proper development strategy has therefore become the key to success”*.

⁸ TWS: True Wireless Stereo

⁹ VAD: Voice Activity Detection

¹⁰ IMU: Inertial Measurement Units

¹¹ LiDAR: Light Detection and Ranging

¹² AR/VR: Augmented and Virtual Reality

¹³ ADAS/AV: Advanced Driver Assistance System/Autonomous Vehicle

¹⁴ PMUT: Piezoelectric Micromachined Ultrasonic Transducer

¹⁵ CMUT: Capacitive MUT

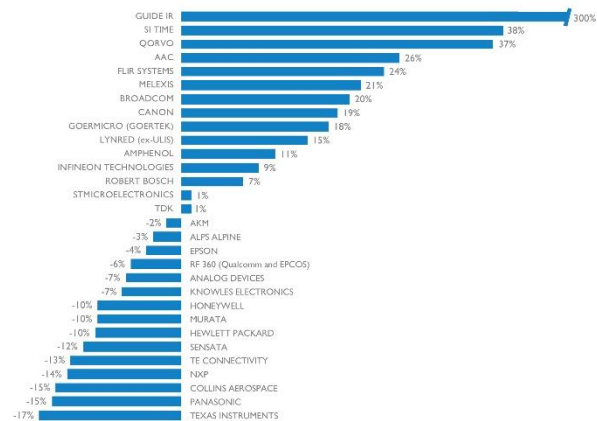
¹⁶ PoC: Point-of-Care

¹⁷ OIS: Optical Image Stabilization

¹⁸ PCB: Printed Circuit Board

2020 top MEMS manufacturers Year-over-year changes

(Source: Status of the MEMS Industry 2021 report, Yole Développement, 2021)



Some players profited from the crisis and some didn't, leading to significant changes in our global MEMS ranking. Bosch, Broadcom, Qorvo, STMicroelectronics, Texas Instruments, Goermicro (Goertek), HP, Knowles, TDK and Infineon now comprise the top-10 with at least US\$6.5 billion combined revenues, more than half of the total market. However, the companies that increased their revenue were not necessarily the ones holding the biggest market shares.

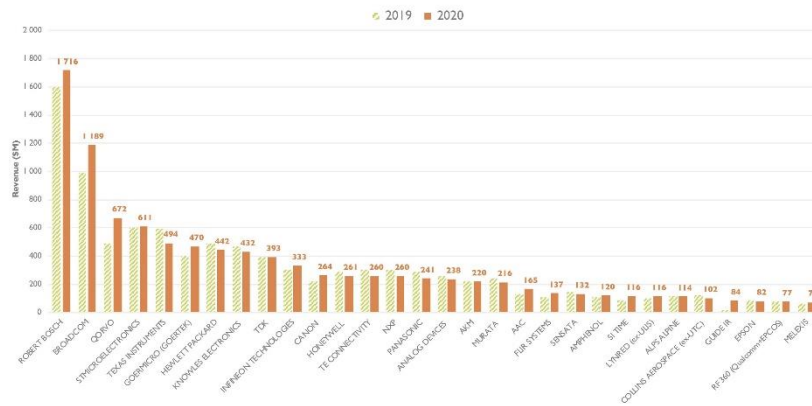
- Companies related to COVID-19 prevention technologies, such as thermal imaging and sensing or pressure sensors, grew strongly last year. For example, Guide IR, FLIR Systems, Lynred, which sells microbolometers, and Melexis, which sells thermopiles, profited due to the increase demand for elevated body temperature measurement application while Amphenol saw its pressure MEMS grow due to demand for respiratory end-systems like ventilators and CPAP¹⁹ machines.
- Broadcom and Qorvo grew strongly last year, providing highly reliable RF MEMS filters for 5G deployment, which was stronger than expected. SiTime is continuing to push strongly for replacement of traditional quartz timing solutions with its MEMS-based timing products.
- AAC and Goermicro (Goertek) profited from a fruitful MEMS microphone demand environment. For the first time in 15 years, the MEMS microphone leader Knowles has been replaced by Goermicro.
- Companies with business both in consumer and automotive like Bosch, STMicroelectronics and TDK, were able to offset potential negative effects from

¹⁹ CPAP: Continuous Positive Air Pressure

automotive due to the impressive consumer MEMS business and the pick-up in demand during H2 2020. Infineon has entered the top 10.

2020 top MEMS manufacturers – In US\$ million

(Source: Status of the MEMS Industry 2021 report, Yole Développement, 2021)



On the technology side, piezoMEMS are devices that should be watched closely. According to **Pierre Delbos, Technology & Market Analyst at Yole**: “PiezoMEMS devices will be getting more attention, as optical MEMS (micromirrors) for AR/VR and LIDAR applications ramp up. Besides that, piezoMEMS are used in RF MEMS, inkjet heads, PMUTs and increasingly used to build more robust inertial sensors and microphones. Foundries have been continuously adding AIN and PZT capabilities.” He adds: “Besides that, MEMS market challenges are evolving. In the past, focus was on product shrinking, price decrease and volume increase. Today, the requirements are changing with use cases being more important while different sensors must fuse with software. Power consumption must fall at the system level even though significant data processing is needed, especially for always-on applications like audio/voice HMI²⁰.”

There is a growing movement toward a mix of competencies across the supply chain, from front-end manufacturing to packaging, the modules and the integration of systems. The move to a system level approach and the integration of different components like MEMS, ASICs²¹, antennas and power sources that use different materials and processes in the same housing, is creating needs for more sophisticated SiP²² technologies, with the goal to increase system level performance and decrease overall power consumption.

Finally, Yole’s analysts are starting to witness the first signs that the devices could emulate and sense their environment with human-like capabilities, using the five best-known senses in a “phy-gital” meta-world. The final step for MEMS would be to evolve from simple deterministic data-collection sensors to more empathic data-interpretation machines. Devices

²⁰ HMI: Human-To-Machine Interfaces

²¹ ASIC: Application Specific Integrated Circuits

²² SiP: System-in-Package

could discern and predict user moods, feelings and emotions, responding and reacting to needs and intentions, much like some humans are empathic

All year long, Yole Développement publishes numerous MEMS & sensing related reports and monitors. In addition, experts realize various key presentations and organize key conferences.



In this regard, do not miss the MEMS World Summit Europe 2021 on September 7-8 in Munich, Germany, with Dimitrios Damianos presentation: “The promises of a bright MEMS future”. Register on [i-Micronews](#).

In addition, discover Dimitrios Damianos’ MEMS presentations during various events, in the Sensing division on [i-Micronews](#).

Make sure to be aware of the latest news coming from the industry and get an overview of our activities, including interviews with leading companies and more on [i-Micronews](#). Stay tuned!

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About our analysts

Dimitrios Damianos, Ph.D., is a Senior Technology & Market Analyst, part of the Photonics & Sensing Division at Yole Développement (Yole). Based on solid technical expertise in imaging, sensing, display, lighting, and photonics, Dimitrios oversees the day-to-day production of valuable technology & market reports and custom consulting projects. Dimitrios also serves as a member of the Custom Project Business Development division (CPBD), supporting the development of strategic projects and following Yole's leading customers within the semiconductor industry. Dimitrios plays a key role in the expansion of Yole's market & technical knowledge, maintaining long-term relationships with key accounts and ensuring their expectations are met. Dimitrios regularly presents and delivers keynotes at international conferences and exhibitions. He has also authored and co-authored several technical & market reports as well as scientific papers in international peer-reviewed journals. Dimitrios holds a BSc in Physics and an MSc in Photonics, both from the University of Patras (GR), and a Ph.D. in Optics & Microelectronics from the University of Grenoble-Alpes (FR).

Jérôme Mouly is Team Lead Analyst in the Sensing & Actuating team within the Photonics & Sensing Division at Yole Développement (Yole). Jérôme manages the expansion of the technical expertise and market know-how of the team. He actively supports and assists in the development of a dedicated collection of market & technology reports as well as custom consulting projects. He has conducted more than 100 marketing and technological analyses for industrial groups, start-ups, and institutes in the field of MEMS and sensing technologies. Jérôme has been also deeply engaged in Yole's finance activities with a dedicated focus on the commercial exploitation of smart system technologies and access to funding opportunities. Jérôme is regularly involved in international conferences, with presentations and keynotes. Jérôme Mouly earned a Master of Physics degree from the University of Lyon (FR).

Pierre Delbos is a Technology & Market Analyst in the Photonics & Sensing division at Yole Développement. Pierre is involved in the development of technology and market reports covering MEMS & sensing technologies, including inertial sensors, microphones, gas sensors and electronic noses. He also collaborates with his team on custom studies for key players in the MEMS Industry. Pierre is preparing his Microelectronics and Photonics Engineering degree at the Grenoble Institute of Technology PHELMA (Grenoble, France).

About the report

Status of the MEMS Industry 2021

The MEMS market will grow due to new opportunities in audio for microphones, microspeakers and inertial MEMS, AR/VR for optical MEMS, and other emerging applications. – Performed by Yole Développement

Companies cited:

AAC, AKM, Alps Electric, Amphenol, Ams, Analog Devices, Apple, Arioso, Asia Pacific Microsystems, Aspinity, Atomica (ex IMT), Audiopixels, Boehringer Ingelheim Microparts, Bosch, Broadcom, Butterfly Network, Canon, Cartesiam, Colibrys, Collins Aerospace (EX UTC), Cirrus Logic, CSEM, Denso, DRS, Epcos, Epson, First Sensor Technology, FLIR Systems, Formfactor, Fraunhofer IPMS, Fujifilm Dimatix, Gettop, Goermicro (Goertek), Google, Hanking Electronics, Hewlett Packard, Honeywell, Imec, Infineon Technologies, Knowles Electronics, Lynred, Maxim, Melexis, Memscap, Memsensing, Memsic, Micralyne, Murata, Nxp, Omron, On Semi, and more...

Related reports:

- [Gas and Particle Sensors – Technology and Market Trends 2021](#)
- [MEMS Pressure Sensors – Technology and Market Trends 2021](#)
- [Wearables in Consumer and Medical Applications 2020](#)
- [Consumer MEMS Microphones Comparison 2020](#)
- [Analog Devices High-End Accelerometers and Gyroscopes Comparison](#)

About Yole Développement



Press Release

Founded in 1998, Yole Développement (Yole) has grown to become a group of companies providing marketing, technology and strategy consulting, media and corporate finance services, reverse engineering and reverse costing services and well as IP and patent analysis. With a strong focus on emerging applications using silicon and/or micro manufacturing, the Yole group of companies has expanded to include more than 80 collaborators worldwide... [More](#)

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