



Key technology for the connected world **Five billion Bosch MEMS sensors** Manufacturing milestone in Reutlingen

February, 2015

PI 8818 AE Ks/af

- ▶ MEMS sensors have been used in automobiles for 20 years, and in consumer electronics for 10 years
- ▶ MEMS sensors are the sensory organs of modern technical systems
- ▶ Small, robust, intelligent, and energy-efficient
- ▶ Bosch is a pioneer and the global leader in the manufacture of MEMS technology

Small parts, big impact: they save lives, increase driving comfort, help conserve energy, and are an essential part of consumer electronics. “MEMS sensors are a key technology for the connected world,” says Dr. Dirk Hoheisel, member of the board of management of Robert Bosch GmbH. “They deliver high performance, but are also small, robust, and extremely cost-effective to manufacture in large volumes.” Bosch recently produced the five-billionth MEMS sensor at its plant in Reutlingen, Germany. MEMS is an acronym for microelectromechanical system. Bosch developed the underlying semiconductor manufacturing process itself, and has been manufacturing the sensors in large-scale production since 1995. “For 20 years, we have been developing smart technology for a growing number of different areas with real-life applications,” Hoheisel says. The first versions were used in motor vehicles to detect pressure and acceleration. Now, 75 percent of all sensors are used in consumer electronics. “Every second smartphone uses Bosch sensors,” Hoheisel says. The company is the leading global manufacturer of MEMS sensors.

Bosch – The pioneer of MEMS technology

The start of large scale production at Bosch in 1995 laid the foundation for modern technology. The current portfolio comprises acceleration, yaw-rate, mass flow, pressure, and environmental sensors, in addition to microphones. While it took 13 years to manufacture the first billion MEMS sensors, the Bosch Automotive Electronics division now manufactures the same quantity in less than one year at

its production facility in Reutlingen, near Stuttgart. This is the result of skyrocketing demand. More than four million sensors are currently manufactured every day. These little helpers have an average thickness of between just one and four millimeters. If the five billion Bosch sensors were stacked on top of each other, the tower would be 12,000 kilometers tall; that is long enough to pass nearly all the way through the Earth, which has a diameter of 12,742 kilometers.

Game consoles, cars, and smartphones – all need MEMS sensors

There are a wide range of uses for MEMS sensors. The SMI700 sensor, for example, records a vehicle's rotational movements, lateral acceleration, and lean angle. It is at the heart of the ESP anti-skid system, which keeps the car more safely on course during critical situations. Another sensor, the SMP480, ensures quieter engine operation and also optimizes the engine's air-fuel mixture in changing environments. This reduces fuel consumption, and provides for cleaner exhaust fumes.

In 2005, Bosch established the wholly-owned subsidiary Bosch Sensortec GmbH, which offers a wide range of MEMS sensors and solutions for applications in the consumer electronics sector, including smartphones, tablets, and wearables. Inertial measurement units (IMU) such as the BMI160 in the remote controls of game consoles are responsible for gaming fun, for example. They transmit the movements of the player in real time with extreme precision. The acceleration sensors in smartphones ensure that the display changes orientation when the cellphone is turned. At the beginning of 2015, Bosch Sensortec unveiled another global first: the BME680. In one housing, this environmental sensor measures air pressure, moisture levels, ambient temperature, and, for the first time, air quality.

MEMS sensors make non-electronic objects smart

The next major technological revolution has already begun. In an increasingly connected world, things are learning how to communicate. MEMS sensors are an important technological component that is key to this process. Bosch Connected Devices and Solutions GmbH, established in 2013, develops and markets connected, sensor-based devices, and custom solutions for the internet of things. Programmed to be a smart technology and fitted with a microcontroller, miniature battery, and a tiny radio chip, MEMS sensors can process their readings and send them over the internet to a user's smartphone, for example.

Tiny, intelligent, robust, and energy-efficient

It is essential for sensors to be as small as possible, especially for smartphones, tablets, and similar devices. The reason for this is that such devices are called on to perform ever more functions – but have to do this in ever less available space. In consumer electronics, MEMS sensors are less than one millimeter thick. Some of the components inside sensors are a mere four micrometers (μm) thick – that is 17 times thinner than a human hair. These tiny parts are nonetheless robust and very powerful. They also have to be extremely energy-efficient. An acceleration sensor for the alarm system in a motor vehicle, for instance, has to be ready for use at all times, yet draw as little power as possible from the car battery. And in consumer electronics, low energy consumption is just as important, since it helps a smartphone's battery last as long as possible.

Press photos: [1-AE-20855](#), [1-AE-20856](#), [1-BST-20778](#), [1-BST-20755](#)

For more information online:

[Bosch sensors for automotive applications](#)

[Bosch sensors for non-automotive applications](#)

[Sensors – how technology maps the world around it](#)

[MEMS: the stars of the sensor world](#)

[Greater safety with peripheral sensors](#)

Bosch press releases:

[Sensors for increased safety in vehicles: New generation of Bosch inertial sensors](#)

[Bosch Connected Devices and Solutions: Bosch sets up company for internet of things and services](#)

[Internet-enabled MEMS sensors](#)

[New Inertial Measurement Unit BMI16: Bosch Sensortec launches first IMU with the lowest consumption worldwide](#)

[Bosch Sensortec launches combo MEMS solution with integrated gas sensor](#)

Videos:

[Bosch MEMS enabling the Internet of Things and Services](#)

[Gyroscope for ESP: how it works](#)

[Pressure sensor: how it works](#)

[Acceleration sensor: how it works](#)

[MEMS sensor manufacturing](#)

[Inertial Measurement Unit BMI160](#)

[Integrated Environmental Unit BME680](#)

[Bosch CES 2015: First environment sensor to measure four variables](#)

Contact person for press inquiries:

Stephan Kraus, phone: +49 711 811-6286

Mobility Solutions is the largest Bosch Group business sector. According to preliminary figures, its 2014 sales came to 33.3 billion euros, or 68 percent of total group sales. This makes the Bosch Group one of the leading automotive suppliers. Mobility Solutions largely operates in the following areas: injection technology for internal-combustion engines, alternative powertrain concepts, efficient and networked powertrain peripherals, systems for active and passive driving safety, assistance and comfort functions, technology for user-friendly infotainment as well as car-to-car and Car2X communication, and concepts, technology, and service for the automotive aftermarket. Bosch has been responsible for important automotive innovations, such as electronic engine management, the ESP anti-skid system, and common-rail diesel technology.

The Bosch Group is a leading global supplier of technology and services. According to preliminary figures, its roughly 290,000 associates generated sales of 48.9 billion euros in 2014. Its operations are divided into four business sectors: Mobility Solutions, Industrial Technology, Consumer Goods, and Energy and Building Technology. The Bosch Group comprises Robert Bosch GmbH and its more than 360 subsidiaries and regional companies in some 50 countries. If its sales and service partners are included, then Bosch is represented in roughly 150 countries. This worldwide development, manufacturing, and sales network is the foundation for further growth. In 2014, Bosch applied for some 4,600 patents worldwide. The Bosch Group's strategic goal is to deliver innovations for connected life. Bosch improves quality of life worldwide with products and services that are innovative and spark enthusiasm. In short, Bosch creates technology that is "Invented for life."

Additional information is available online at www.bosch.com, www.bosch-press.com, <http://twitter.com/BoschPresse>