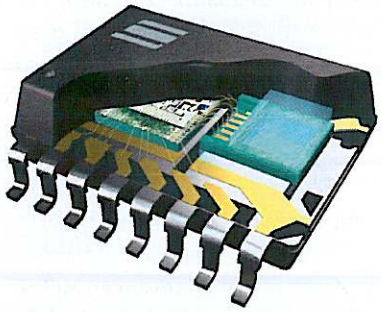
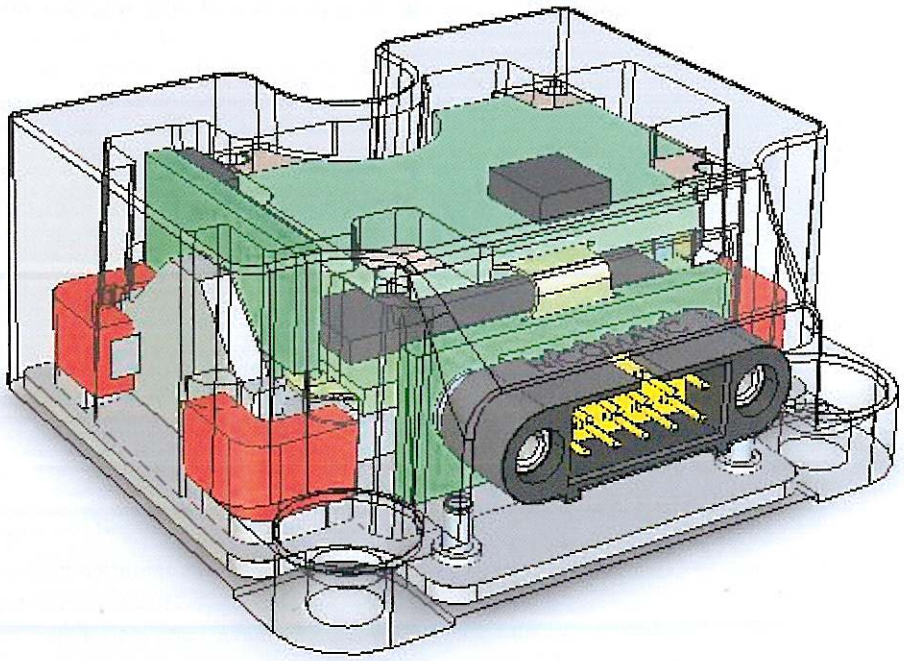
MEMS for High Precision - that's SensoNor Technologies AS



SAR10HZ Gyro in DIL plastic package



SIMU202 Gyro cluster with 3 orthogonal channels

After having been part of Infineon Technologies since the summer of 2003, SensoNor is back as an independent company with Norwegian investors from 1st of March 2009. The new company plan to make a real difference in the industrial sensor community by focusing on products based on MEMS technology, but for High Precision applications.

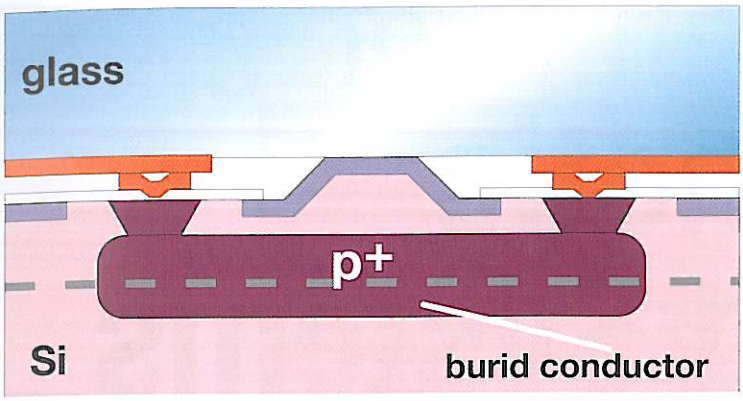
Based out of Horten, a small town 100 km south of Oslo, SensoNor has for 24 years played a significant role in the development of the global MEMS industry. Over the years more than 150 million pressure sensors, more than 35 million accelerometers and more than 2 million gyros have been shipped to customers for use in numerous type of applications. The automotive market has been the primary target. The legacy of silicon based sensors at SensoNor goes even further back. Already in the late sixties the mother company, AME, started up with pressure sensors and accelerometers based on piezo resistive micro machined silicon strain gauges and from the late seventies with etched diaphragm silicon sensors.

In contrast to many of its competitors, SensoNor has never been afraid to explore new grounds for use of MEMS technology and to look for new applications. The impressive list of global "firsts" clearly shows the dedication and capability:

- First MEMS based pressure sensor for Air Data Systems (SP80 - 1985)
- First MEMS based accelerometer for Air Bag Systems (S64A – 1987)
- First optical pressure sensor for Down Hole Well Monitoring (PP05 – 1990)
- First low cost Air Bag Accelerometer (SA20 - 1992)
- First integrated micro system for Tire Pressure Measurement (SP13 - 1998)
- First low cost Automotive Gyro (SAR10 - 2003)

Of particular interest was the SA20 air bag accelerometer that moved the company from being a "development" company to a real industrial actor. Also the SP13 meant a paradigm shift, introducing advanced microelectronics into the sensor in form of ASIC within the same package as the MEMS sensor element; a strategy that soon was copied by most MEMS companies.

Being "first" is not always a good thing. However, SensoNor ended up being the world's #1 for air bag sensors and for tire pressure sensors for number of years. Probably the most important reason is the extremely low failure rate experienced for the shipped products; less than 1 failure in 10 million parts.



Hermetic wafer bonding using combination of diffused buried conductors and anodic bonding

During the past ten years, the MEMS sensor technology has played a more and more dominant role within automotive and consumer volume applications. The reason is obvious, and explained by the superior advantages of MEMS compared to conventional technologies: Lower cost due to wafer based high volume manufacturing technology; smaller size, lower weight and less power due to semiconductor technology; more robustness due to lower weight, higher electrical integration and less self generated heat.

In opposition to the MEMS success within automotive and consumer, there are very few examples where MEMS play an important role within High Precision sensing applications. Even today the SP80, launched in 1985 and used e.g. in air data systems, is one of few MEMS products that is successfully combating technologies like vibrating metal cylinders, vibrating quartz elements and capacitor metal diaphragms. It is obviously a tricky optimization and even a paradox to achieve High Precision performance when the size goes down, as is the case when utilizing MEMS. Never the less, this under-developed field is exactly what intrigues and encourages SensoNor. This new challenge fits well with the company's cultural history of being first with reliable and capable solutions.

During the early nineties, SensoNor developed its triple stack hermetic wafer bonding technology that has showed extremely good long term properties. In short the technology is based on a combination of micro machined single crystalline silicon and micro machined glass wafers. These wafers are then bonded together using anodic bonding in combination with creating electrical connections into the bonded cavity, using semiconductor diffusions buried under a layer of epitaxial silicon.

The stable long term properties have been further explored within High Precision application by customers using the SW400 series pressure dies with buried piezo resistors as well by customers using the SW510 series gyro dies based on the "butterfly" concept. In particular the close cooperation between Imego and SensoNor has proven the potential of MEMS for High Precision inertia applications. Imego has developed concepts and solutions that fits perfectly and enhances the function and performance of the SensoNor gyro elements. In particular the digital algorithms developed complementary to the IBG20 solution is valued as beyond state-of-art.

SensoNor will during 2009 launch a number of High Precision pressure sensors and gyro products aiming to: A) Replace traditional High Precision metal-, quartz- and fiber optic technology, offering lower cost and better robustness, in smaller housings, using less power at equal performance. B) Enable new High Precision applications, offering low cost and high robustness, in small housings, using low power at performance levels not available in today's market.

The SAR10HZ and SAR100 are both further developments of the SAR10 automotive gyro, but with emphasize on lower noise and better bias capability. Of particular interest and importance is the SIMU202 gyro cluster. The cluster consists of 1-, 2- or 3 gyro channels each utilizing the SW510 series gyro in combination with the unique Imego IBG20 technology. The gyros are synchronized and stabilized by a micro controller utility function and are "plug-and-play" compatible and meet the same performance requirements as lower grade Fiber Optic Gyro's (FOG's). Compared with the FOG's a number of additional functions are available like programmable filter and sampling functions and advanced self diagnostics. The size, weight and power consumption are tremendously improved over the FOG's.

Being in the forefront of advanced MEMS requires the most efficient research and development arrangements. SensoNor has a tradition for very close working- and program relationship with research institutions. The Microsystems and Nanotechnology group at SINTEF, the largest independent research organization in Scandinavia, is traditionally involved when new MEMS processes are needed as part of product development. In recent years also the local Vestfold University College has played an important role. The cooperation with Imego on gyros has been instrumental in creating the "new" SensoNor and further success is much relaying on a very close and complimentary cooperation with Imego. Also SensoNor's cooperation with Acreo on advanced new thermal imaging components is of much importance. The target is to offer non-cooled bolometer focal plane arrays (FPA's) based on Acreo's unique Si/SiGe crystalline quantum well structure, offering the best signal-noise ratio for High Precision applications.

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