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# Fuel level measurement for commercial and special-purpose vehicles

- Robust
- Innovative
- Efficient

VDO

# Efficient fuel management

Small cause – great effect: A rule that fully applies to fuel level measurement systems. This is why the reliable collection of fuel levels for commercial and special-purpose vehicles is considered a prerequisite for predictable and efficient vehicle availability.

**Innovative solutions**

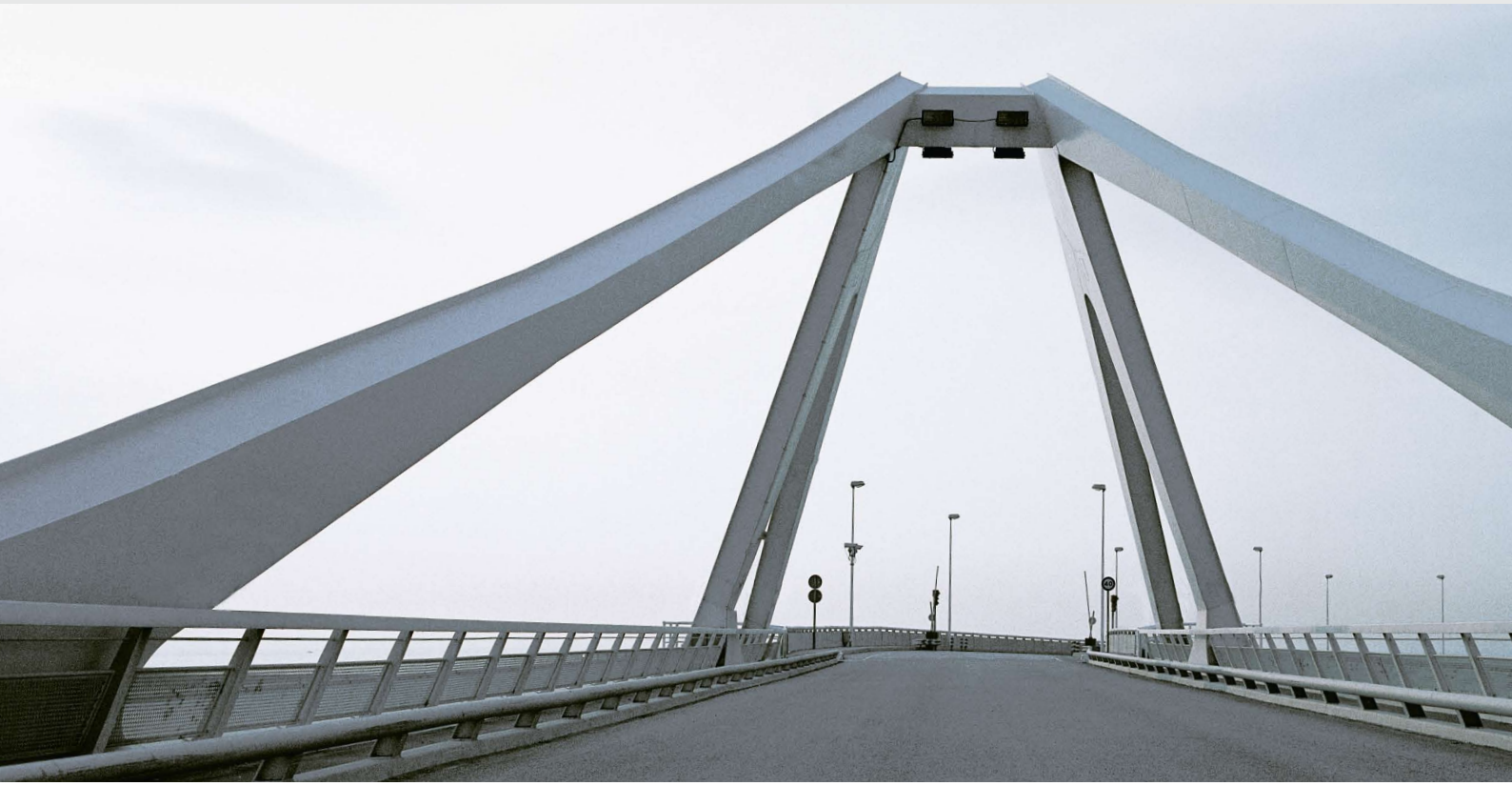
Our sensor systems are optimized specifically for this area of application with its sometimes very difficult environmental conditions. We have been active in this area for over 30 years, and with sensor innovations such as the magnetic passive positioning sensor (MAPPS) have created the conditions for being able to significantly extend the service life of fuel level measurement systems – even in aggressive fuels.

**For each tank geometry**

With an extensive assortment of basic concepts we supply solutions for a large number of different tank geometries, flange openings (e. g., EU bayonet flange) and fuel requirements. On the basis of a modular principle we are also able to assist our customers with products in smaller quantities. In this view customer-specific lever arm sensor lengths can be implemented starting as of approximately 2,000 units annually.

**Scaleable levels of integration**

Our extensive assortment of sensor solutions includes classics such as dip pipe sensors and lever arm sensors with thick-film network technology (DSN) sensors, as well as contactless sensors which are therefore free of wear and tear. Depending on the requirements of the tank or vehicle manufacturer, functionality options range from robust sensors of a simple construction up to complex solutions including connections for fuel supply (feed and return line for engine injection system and auxiliary heating system) as well as ventilation of the tank, all of which are integrated in the flange geometry. Regardless of the functional principles and design, all systems are designed for a long service life and have been proving themselves in series for many years.



**DSN technology**

Sensors in thick-film network technology are a popular standard because they provide reliable fuel level measurements and allow for a customised preparation of resistance characteristics diagrams for asymmetrical tank geometries. Our estimated delivery quanitites for 2008 alone are approximately 30 million units.

We use several designs of lever arm sensors with sensors in thick-film network technology for a variety of sophisticated requirements: The standard edition includes two grip contacts in AgNi20 and is designed for one million cycles. Also available is a 3-finger system with two sets of three contacts which, depending on the contact material, is designed for one million cycles (Hera 649 material) or two million cycles (AuNi5).

**One sensor principle – different tank depths**

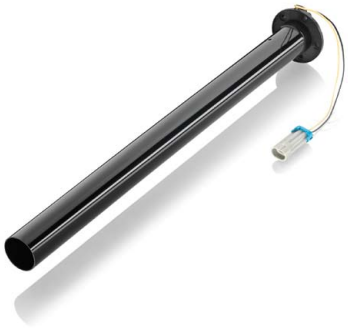
We offer efficient solutions even for this requirement. The new type ALAS II (Adjustable Lever Arm Sensor, second generation) fuel lever arm sensors can be adjusted for different tank depths in the range of 100 and 400 mm. This allows a vehicle manufacturer or tank system specialist to equip different tank depths of an entire model series with one single sensor principle. This solution is especially advantageous for smaller quantities, as is typical for special-purpose vehicles.

**Ultrasound measurements up to an incline of 15°**

There is another contactless measurement system which has been proving itself for three years in other application areas: Our ultrasound system ULL (Ultrasonic Liquid Level) measures the quantity of fuel in the tank by measuring the distance to the liquid level.

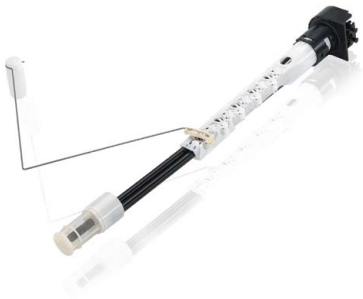
The technical principle is based on the measurement of the signal delay between the signal output and the recording of ultrasound waves reflected from the surface of the fuel (Time of Flight). Our system also contains special algorithms to compensate for the effects of swashing fuels (slosh). In the case of complex tank geometries, the ULL system offers the advantage of storing characteristics curves in the sensor module and hence further improving the linearity of the display. However, in contrast to other sensor systems a ULL cannot display all electrical output values due to the principles underlying this system.

At the current time the ULL system works with inclines of up to 15°. A ULL concept with integrated infeed and return feed is in the concept stage for off-highway use.

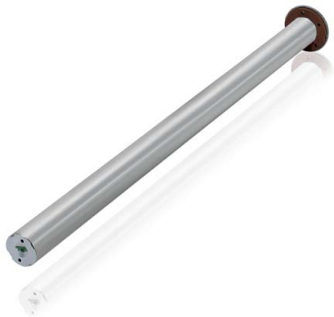


Ultrasound fuel level sensor ULL for contactless measurements of fuel levels. Algorithms correct slosh factors.

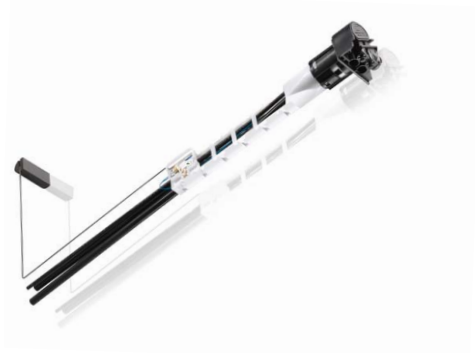
Principle behind ultrasound fuel level measurements. The delay between outgoing and reflecting sound waves corresponds with the distance to the liquid level.



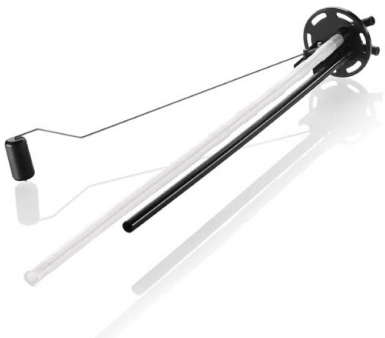
Plastic lever arm sensor (DSN technology)



Metal dip pipe sensor

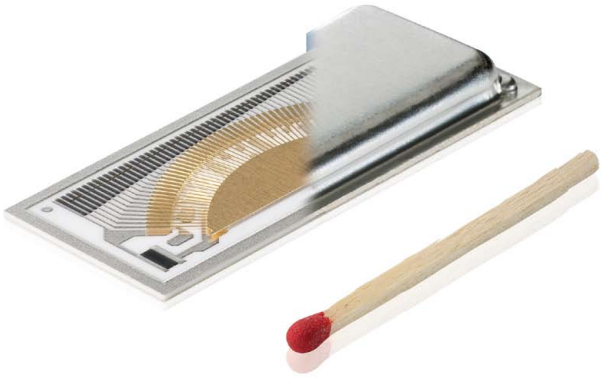


Plastic lever arm sensor (MAPPS technology)



Type ALAS II adjustable lever arm sensor

# Contactless measurements for aggressive fuels



The hermetically sealed MAPPS element at a length of only four centimetres.

**MAPPS functionality:** The magnet on the lever arm sensor pulls down flexible contact pads on a contact board, producing a characteristically electronic resistance signal.

While conventional sensor technologies in fuel and diesel achieve the required service life requirements, these values cannot automatically be transferred for use in new fuels, such as rapeseed oil methyl ester (RME, biodiesel). In the case of conventional sensors in RME thick film technology, aggressive components can accelerate the wear and tear of contact surfaces, even for high-quality contact materials. Contactless measurements represent a more secure method of achieving long-term fuel level measurements in these different basic conditions.

Our MAPPS meets this requirement. On the basis of its functional principles, the sensor can achieve over ten million cycles. The actual sensor element of this patented sensor is hermetically sealed and hence does not come into contact with the fuel. Measurements are carried out via a lever arm sensor, which moves a small magnet in a bow-like manner over the outside of the sensor housing. The magnetic force pulls individual metal pads (of a total 52) on a contact board on the inside of the sensor, producing a characteristic electrical resistance which is the measurement value.

Even though MAPPS is a relatively new technology which has only been produced in series since 2001, we are already expecting annual production volumes of approximately ten million units for 2008. This innovative sensor is well on its way to becoming a future standard.

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