

CANopen and J1939 sensors for agricultural technology

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Figure 1: Field sprayer

Just as with commercial vehicles, agricultural machinery is benefiting from the capabilities of modern automation technology. Among the tasks, sensors play a central role in measuring inclination angles, detecting terrain type and controlling vehicles. Following the current trend towards non-contact, wear-free operating principles, Pepperl+Fuchs (Germany) develops capacitive, inductive, ultrasonic and other sensors designed for the requirements of agricultural engineering. Terms such as “smart farming” and “precision farming” sum it up. Tractors and attachments are becoming equipped with on-board computers and electronic control devices that enable the ma-

chines to optimize processes in the agricultural field. However, this is only possible if the sensors consistently deliver sufficient and current information about machine status and field conditions.

Mechanical and electrical properties of agricultural sensors differ from their counterparts in factory automation. Machines are exposed to dirt, moisture, fuel, hydraulic oil, road salt, fertilizers and pesticides on a daily basis. Only stainless steel designs are capable of meeting the requirements for chemical resistance. Mechanical robustness and resilience are also required in order to withstand vibration and severe shock.

In addition to the analog current and voltage in-

terfaces, standard interfaces using such protocols as CANopen and J1939 are also required. Vehicles cannot travel on public roads in Europe without e1 approval. From an electromechanical perspective, connection types must be adaptable to the relevant standards and manufacturer’s specifications. ISO 14982 contains information on the basic requirements specified for agricultural and forestry machinery.

Manufacturer’s range of sensors for agricultural technology incorporates the key technology types required to solve the detection tasks in agricultural applications. The sensors have a smooth and robust housing suitable for use under harsh conditions in outdoor ▶

environments. Furthermore, they satisfy the necessary criteria for electromagnetic compatibility (EMC) and offer a degree of noise immunity (100 V/m) that exceeds the minimum required values.

Inclination and acceleration sensors

In view of the increased size and complexity of agricultural machinery and the trend towards automatic drive systems, monitoring the inclination angle of machinery has become important. F99 series inclination sensors are suited to continually monitor and level vehicles, attachments, driver's cabs, etc. The sensors detect the inclination angle between 0° and 360° at resolutions of lower than 0,1° and are available in a one- or two-channel design. On request, the measuring ranges and outputs can be configured prior to delivery. In addition to models with 4-mA to 20-mA current interface, 0-V to 5-V voltage interface and CANopen network connection, the inclination sensor is available with a J1939 interface. The sensor fulfills IP68 and IP69K degree of protection and can be mounted directly to the vehicle using the sensor's integrated mounting design. Acceleration sensors from the same series are similar to the inclination sensor and detect short-term dynamic influences and forces on the vehicles and attachments.

For distance and load measurement

Ultrasonic sensors generate sound waves and have an averaging function. These are used for measuring distances on uneven surfaces, such as farmland, and the fill level of fluids and trailers, warehouses or silos containing seeds or harvested goods. On guidance systems that use furrows or grooves as

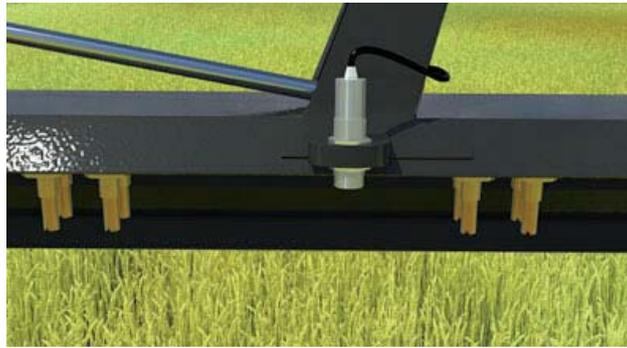


Figure 2: Ultrasonic sensors monitor the spraying arms to maintain a constant distance between the nozzles and the ground and ensure that fertilizer is spread evenly over fields

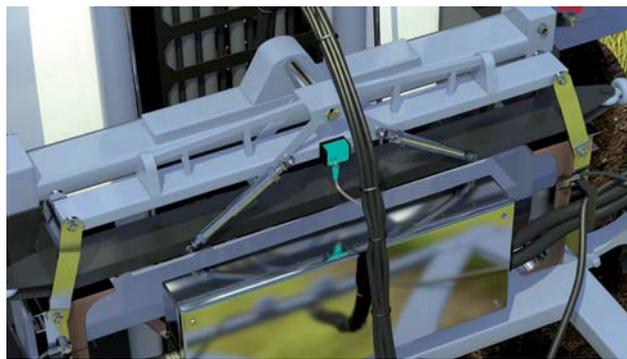


Figure 3: Inclination sensors monitor the level of the sprayer boom on a field sprayer



Figure 4: The F99 inclination sensor with CANopen or J1939 interface

a reference point, the generated signal is more accurate than signals generated by other technologies such as GPS. Ultrasonic systems are insensitive to soiling and therefore have the edge over camera systems, whose lenses present problems in dirty environments.

On field sprayers with large, extended spraying arms, ultrasonic sensors help keep the nozzles at a constant distance from the ground without using mechanical devices and ensure that fertilizer is spread evenly over fields. A ground distance monitoring system protects the spraying arms connected to the vehicle from damage.

The UMC3000 metal face sensor is just one example from the large selection of ultrasonic sensors. The sensor has a stainless steel housing and operates without a separate receiver module. It has a diameter of 30 mm and has a metal transducer on the front.

Capacitive and inductive sensors

Operator panels on agricultural machinery are often fitted with joysticks for controlling forks or attachments. A capacitive sensor integrated in the joystick tells the on-board electronics if the operator is actually moving the joystick. If the

operator is not touching the joystick, the engine speed and hydraulic pressure are reduced to save fuel, and safety functions, such as brakes and interlocks, are activated when necessary.

Inductive sensors are used in numerous agricultural applications. Cylindrical sensors with an M12 or M18 threaded metal housing are substitute for mechanical switches. They detect the presence of metallic machine components and the status of flaps, conveyors, harvesters and other components. The PMI, F90, F110 and F130 non-contact positioning systems also function according to the inductive principle and are used to detect rotation angles on steering systems and measure linear movements and paths on hydraulic systems.

The manufacturer offers a number of further sensor systems for agricultural technology to achieve "precision farming", e.g. RFID (radio frequency identification) solutions for identification tasks, heavy-duty rotary encoders, safety rotary encoders and vision sensors in a solid metal housing. To make it easier for machine manufacturers to integrate agricultural sensors in their products, the company offers a selection of connector solutions that can be adapted to customer requirements. These solutions support the standards of manufacturers such as Deutsch Industrial, TE Connectivity, Delphi, JST, Lear, ITT and Molex. Sending connectors and cables for separate assembly is no longer necessary. This allows immediate commissioning of the devices. ◀