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Precise, reliable and adaptable:

Linear conductive plastic potentiometers for mobile use

Modern commercial vehicles are highly automated as this is the only way of ensuring the efficiency necessary for economical operation . The same applies, of course, to agricultural machinery. This development is exemplified by concepts such as "smart farming" or "precision farming". Sensors are crucial in this development as they supply the on-board computer with the necessary data, for example for a variety of different positioning tasks. It is not only essential to capture position and angles accurately, a high degree of reliability is also necessary outside in the tough conditions of mobile applications. This is where the advantages of conductive plastic potentiometers are clearly demonstrated. Due to their precision, reliability and cost-effectiveness they have no serious competitors in meeting mandatory quality standards. They can also be adapted to special applications as is shown by the following example, where linear conductive plastic potentiometers are used in a precision seed drill.

Although today there is a trend towards non-contact models, however, in practice conductive plastic potentiometers continue to have a very large market share. Reliability in the field is often advanced as an argument for preferring

non-contact sensors over a potentiometric solution. However, due to their well-engineered technology, potentiometric position and angle sensors can, in suitable applications, achieve a level of reliability never achieved by non-contact methods. Users of mobile applications particularly appreciate the non-electronic design of potentiometric angle sensors. Fewer components mean fewer potential sources of error, especially when the going gets tough. Their electromagnetic compatibility is particularly suited to applications in commercial vehicles, and today high quality conductive plastic potentiometers also score in terms of longevity, having a service life of 100 million cycles.

Precision seed drill with a large operating capacity

The sensor technology specialist Novotechnik (see text-box 1) has a series of robust potentiometers in their product range with proven reliability under extreme conditions. One of these is the TX2 series of linear position transducers (Fig. 1). These compact sensors with 300mm stroke length comply with IP67 protection standards and are suitable for use in ambient temperatures from -40°C to $+85^{\circ}\text{C}$ (plug connection) or from -20°C to $+100^{\circ}\text{C}$ (cable connection). The robust design consisting of a metal body, metal flanges and double actuating rod seals is suitable for many different applications even in harsh environments such as dirt, dust and liquids. That is why these economically priced position sensors are widely used in the agricultural sector, having a resolution of better than 0.01mm and a linearity of up to $\pm 0.05\%$. They have also proved to be adaptable to some very demanding applications.

The agricultural machinery specialist Kverneland, (see text-box) has put the Optima TFM Maxi on the market, a modern precision seed drill with a 12m working width which enables the extremely precise and efficient sowing of seed and fertilizer (Fig. 2). Fertilizer is fed in simultaneously between the individual seeds, ensuring that the seedlings have sufficient nutrients during the growing period but without burning them. The machine is fitted with a 4,000 litre fertilizer hopper.

Potentiometers monitor the folding mechanism.

As the vehicle has to travel on public roads to reach its working area it is limited to a maximum width of 3m as prescribed by traffic regulations. This is achieved by a sophisticated mechanism which automatically folds the sections of the

frame together (Fig. 3). "It works like an umbrella," explains Jörg Fischer (fig. 4) of R&D Soest Team Precision Seeders, part of the Kverneland Group Soest GmbH. "At the touch of a button the operator can put the hydraulically-powered sections into either the transport position or working position."

The trouble-free unfolding and folding operation is monitored by the seed drill's on-board computer. In order to control and monitor the sections it is necessary to know their positions and distance of travel. This is where the previously described conductive plastic potentiometers come into play. There are seven of these sensors built into the machine, located near the pivots of the folding mechanism (Fig. 5). They supply data to the on-board computer in the form of an analogue signal proportional to the distance travelled, which controls the folding operation.

Pivot heads and gaiters

"Being able to fix the sensors with the ball joints is particularly useful," Fischer goes on, "as after all, there's no machine base with mobile applications. Instead, you can fix the sensors at two points where the backlash-free pivot heads permit an angular adjustment up to 12.5°." A metal PG cable gland provides the electrical connection.

However, the standard IP67 protection standard was not sufficient for the air seeder. Although there was no problem cleaning the machine after use and the sensors were intact and working properly, "dirt and fertilizer deposits on the actuator rods were critical," as Jörg Fischer confirms. Help was at hand in the form of a comparatively simple but very effective modification. A concertina-type gaiter made from a type of plastic resistant to fertilizer and cleaning materials provided the required protection. The material does not become brittle even at low temperatures thus providing the actuator rods with reliable protection against deposits. The gaiter is slipped over the potentiometer and fixed to its collar with cable ties. Ventilation is provided by a rubber ring inserted at one point of the rubber collar. This forms a narrow ventilation slot which is located in a way that practically no moisture can penetrate.

"This solution has since proved its worth in every day working practice," as Fischer is pleased to confirm. Once again potentiometers prove that for mobile applications there are hardly any alternatives—especially when you take the

price-quality ratio into consideration. But these robust position sensors have also proved their reliability in industrial applications. Additional connection and fixing options allow for easy adaptation to requirements of the relevant application.

- Fig. 1 Standard compact sensors with 300mm stroke length comply with the requirements of IP 67 protection. The actuator rods are protected from deposits by a concertina-type gaiter made of a plastic material resistant to fertilizer and cleaning materials. (Photo: Novotechnik)
- Fig. 2 Modern seed drill with 12m working width (Photo: Kverneland)
- Fig. 3 The folding mechanism reduces the width of the machine to 3m to permit driving on public roads. (Photo: Kverneland)
- Fig. 4 Jörg Fischer, R&D Soest Team Precision Seeders, from the Kverneland Group Soest GmbH: "Being able to fix the sensors with the pivot heads is particularly useful," Fischer goes on, "as after all, there's no machine base with mobile applications. Instead, you can fix the sensors at two points where the backlash-free pivot heads permit an angular adjustment up to 12.5°." (Photo Kverneland)
- Fig. 5 Seven linear conductive plastic potentiometers are built into the machine. They are fitted close to the pivot of the folding mechanism. (Photo: Novotechnik/Kverneland)

Text-box About the Kverneland Group Soest GmbH

Kverneland Group is a leading international company developing, producing and distributing agricultural machinery.

The Soest plant is the Kverneland Group's competence centre for seeding technology. Through its intensive research and development work the Kverneland Group Soest GmbH has launched many pioneering innovations and has an annual turnover of over EUR 70M.

Text in the box: About Novotechnik

Novotechnik located in Ostfildern, Germany has been a leader in the development of measuring technology for more than 65 years. In Germany alone over

200 employees work at peak performance. This results in high-performance linear transducers and angle sensors, that are today indispensable for production, control and measurement technology as well as automobiles around the world. The very wide product line includes linear transducers and angle sensors of various functional principles, special solutions for the automotive area, signal conditioners and measuring devices. These covers practically all the imaginable tasks; custom-made solutions are available for special application needs.

Use free of charge. Please direct reader queries to Novotechnik.

Characters without text in box: approx. 6.300

Text in box 1 „About Kverneland“: approx. 370

Text in box 2 „About Novotechnik“: approx. 700