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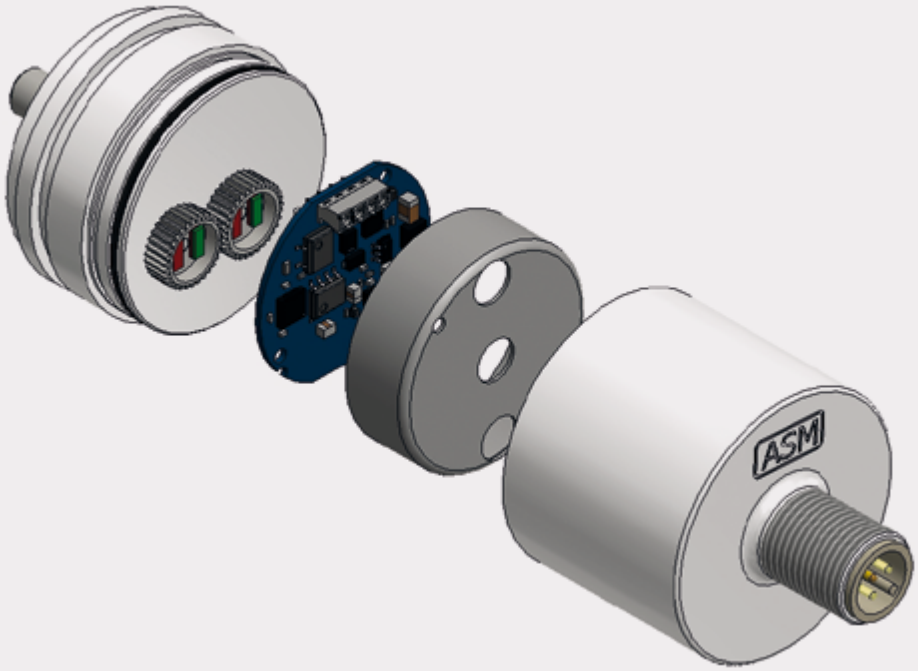
MAKE IT MAGNETIC

ACCURATELY MONITORING THE ANGULAR POSITION OF A VEHICLE REQUIRES A ROTARY CONTROLLER. BUT IN HARSH INDUSTRIAL CONDITIONS, SOME ENCODER TECHNOLOGIES PERFORM BETTER THAN OTHERS



The true absolute magnetic encoder technology uses a gear coupled multi-hall sensor system

Rotary encoders detect angular position and convert it into an analog or digital signal. Used in industrial and off-highway vehicles, rotary encoders often face harsh environmental conditions such as heavy shocks and vibrations, water, humidity, dust, dirt, oil and extreme temperatures. Choosing the wrong technology can lead to sensor failure, vehicle downtime, costly vehicle recalls and a loss of customers. As different encoder types are available, it is worth considering the performance of optical encoders and magnetic encoders before presenting an example of new magnetic true-absolute encoder technology.

The main component of optical encoders is a coded disc made of glass, plastic or metal. The disc is connected to a movable component by a solid or a hollow shaft. As it moves, a photo detector reads the optical disc pattern and generates a digital incremental or absolute signal, which can then be processed by an electronic control unit.

Optical encoders used in the setting of harsh environmental conditions can easily be pushed to their limits. Penetration of humidity or water into the sensor housing by capillary action along cables and seals can affect the function of the encoder disc, poor sealing may lead to contamination of the encoder disc by dust and oil, while shocks can destroy the sensor's components. Such problems can lead to early sensory failure.

Magnetic encoders perform far better

In contrast to optical encoders, magnetic encoders work on the basis of ferromagnetic measuring standards and modulate a magnetic field. The modulation of the magnetic field is detected and evaluated by hall or multi-hall sensors. They are connected to a microprocessor, which calculates the absolute angle by basing its computations on the proportions of the hall elements.

Unlike optical encoders, which have fragile and breakable code discs, magnetic encoders are resistant to shocks and impacts. Humidity, dust, water or oil penetrating the sensor housing will not affect function. Compared with optical encoders, magnetic encoders are more able to tolerate harsh environmental conditions.

Weaknesses of current technologies

Despite the advantages of magnetic encoders, conventional designs still have a weakness. They can be disturbed by magnetic interference due to the number of rotations being counted one by one. To overcome this weakness, ASM Sensors have developed a magnetic gear-driven nonius-principle-based technology to ensure a true-absolute output.

The true-absolute magnetic encoder

The new Posihall true-absolute magnetic multi-turn encoder technology measures the absolute angular position of a shaft over multiple revolutions by using a gear-coupled multi-hall sensor system that uses a magnetic nonius (vernier) principle. This true-absolute technology ensures reliable and correct positioning even in areas of high electromagnetic influences. In the event of disruptions, for example, by a power failure, correct measurement data is immediately available again.

The Posihall technology measures 'true absolute' and therefore reliably detects position even under strong electromagnetic influences

Posihall sensors can be mounted directly onto the machine's rotation axis. The sensor electronics are completely enclosed and protected by a rugged housing. The non-contact magnetic multi-hall technology is able to reliably detect measuring data even if the machine housing is filled with water or oil. The sensor body has an integral shielding against magnetic fields. It works in environments with magnetic field strengths of up to 0.5T. Posihall angle sensors operate reliably and precisely with high levels of shock and vibration, and can withstand temperatures -40°C to 85°C.

If it is going to be used outdoors, in harsh environmental conditions, then magnetic encoder technology is, by far, superior to optical encoders. Nevertheless, magnetic interference can certainly impair correct position detection in the technologies that are currently on the market. The Posihall true-absolute magnetic encoder technology successfully overcomes this weakness and offers a completely new solution for correct and reliable angle measurement. **iVT**

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Table 1: Comparison of multi-turn encoder technologies

Parameter \ Technology	True absolute multi-turn hall encoder with gear (Posihall)	Quasi absolute multi-turn HALL encoder with incremental revolution counting	Absolute multi-turn optical encoder with gear
Resolution single + multi-turn	14+5 Bit (31 turns), 14+8 Bit (255 turns)	14+12 Bit (4086 turns)	14+12 Bit (4086 turns)
Linearity single turn 360°	0.3%	0.3%	12 arc seconds
Multi-turn technology	**Robust planar nonius gear with 2-6 gear wheels**	**Revolution counter based on add-on sensors (reed switch, hall switch, pulse wire) battery powered or energy harvesting from counting pulse**	**Multi-stage gear with 4 gear wheels**
Sensitivity to shaft load or shaft overload	Insensitive against shaft load and transient shaft overload, blocked bearings	Insensitive against shaft load	Code disc can be misaligned against sensor chip; air gap <0.05mm; glued and unblocked bearings can lead to sensor failures at normal shaft loads
Influence of external magnetic fields	Integral shielding against external magnetic fields up to 0.5T	Shielding of housing possible	Strong external magnetic fields can lead to a saturation of inductors
Redundancy	Full dual channel redundancy	Complex and costly	Costly
Diagnostic coverage	Medium to high	Low	High with completely absolute evaluation/ interpretation (no counting of turns, since susceptible to interference)
Reliability	High reliability due to low complexity single technology design. Electronic circuit protected by full potting encapsulation	Average reliability due to multi-technology design, no protection by potting possible	Reliability in extreme outdoor conditions not always guaranteed
EX-protection	Ex protection zone 22 Dust complete encapsulation by potting	Potting not possible	Potting not possible
Functional Safety SiL	Up to SIL3	None	Up to SIL3
Protection classes	IP67 is standard	IP69K / IP68 (500m) possible	IP65 (IP67), IP69K available
In-Hydraulic cylinder integration	Possible	No	No
Hollow shaft version up to ⌀mm	Possible but costly	Possible but costly	Up to approx. 85mm (complex, costly)