One For All: Turck's inductive encoder can be parameterized via IO-Link with 100 different characteristics and configurations

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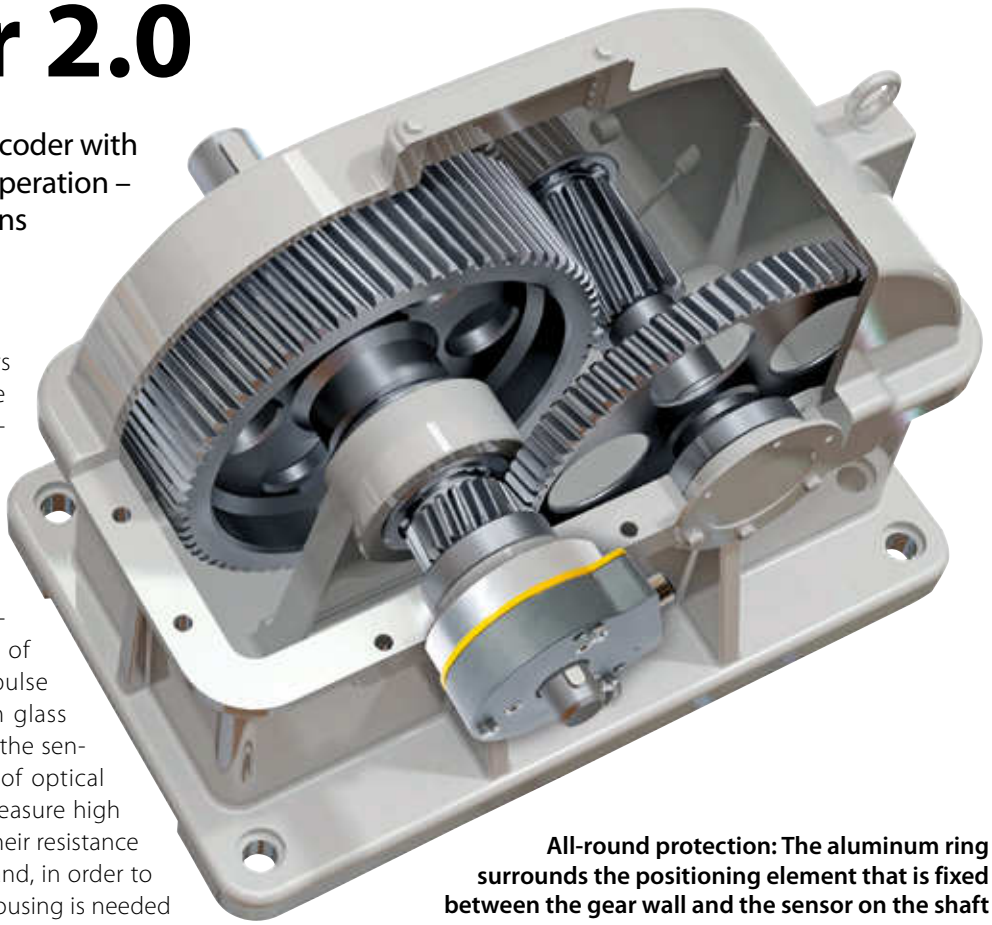
Encoder 2.0

The world's first inductive encoder with non-contact and wear-free operation – even at the highest resolutions



All-round protection: The aluminum ring surrounds the positioning element that is fixed between the gear wall and the sensor on the shaft

The world of rotary encoders is divided. On the one side are the advocates of optical and potentiometric encoders, and on the other, the proponents of magnetic systems. Optical encoders are used as absolute or incremental encoders. They measure angles or rotations by transferring the rotational movement of a shaft onto an optically-coded pulse disk which is typically made from glass or plastic. An optical system inside the sensor scans this disk. The strengths of optical encoders include their ability to measure high resolutions and speeds, as well as their resistance to magnetic fields. On the other hand, in order to measure high resolutions, a large housing is needed due to the necessary size of the disk.

The greatest disadvantage, however, is that direct mechanical connection is required by their design. Any blows to the shaft may destroy the pulse disk which is connected directly to the shaft. Vibrating shafts alone can have an effect on the sensitive design over time. Although the electrical system operates wear-free, this is little use if the mechanical system wears out prematurely. Manufacturers recognize the Achilles heel of optical encoders and try to minimize vibrations. Mounting accessories such as couplings or spring elements have been designed to dampen the mechanical load. Other manufacturers are fitting their encoders with paired ball bearings or are relying on gearless variants.

Wear on conventional encoders

All these measures, however, can only mitigate the basic design weakness of these devices. Sooner or later, the mechanical connection between the machine shaft and the encoder will produce wear – either at the spring elements, seals or at the encoder itself. The same issues apply to potentiometric encoders: They achieve high resolutions at the expense of a robust design. Potentiometer manufacturers make no secret that a potentiometer is a wear part.

The seal of the encoder housing is often the central weakness. Eventually it becomes brittle, cracked and then leaks and can crack due to the permanent load caused by the rotating shafts. Penetrating water or dirt damage to the sensitive sensor circuit can cause failure. Optical and potentiometric encoders only comply with high degrees of protection under optimal conditions.

With magnetic systems, the issues are quite the opposite as their strengths lie in a relatively high mechanical load capacity. The measuring principle involves the use of a rotating magnet which forms and discharges a magnetic field. This produces a sine-cosine curve and is evaluated as a rotation signal. Magnetic encoders are non-contact measuring devices. Their electronics can be completely enclosed and encapsulated. The weakness of the magnetic encoders available in the market, however, is their susceptibility to electrical or magnetic interference and their intolerance to the offset of the positioning element, which means they have to be operated in a housing which precisely positions the encoder. The resolution of the magnetic devices depends on the speed of the shaft to which they are connected.

For users who cannot ignore the weaknesses of either the optical or magnetic systems in their installations, Turck has developed a new class of encoder that operates on the inductive resonant circuit measuring principle. Automation specialists have been successfully using this technology in their position and angle applications for the past two years. The RI360 inductive

Quick read

The RI360P-QR24 inductive encoder developed by Turck is the world's first encoder for the non-contact measurement of rotary movement, even with a high resolution. This is the only encoder type that offers absolutely wear-free operation and stays permanently sealed – so that it can never end up as electrical waste.

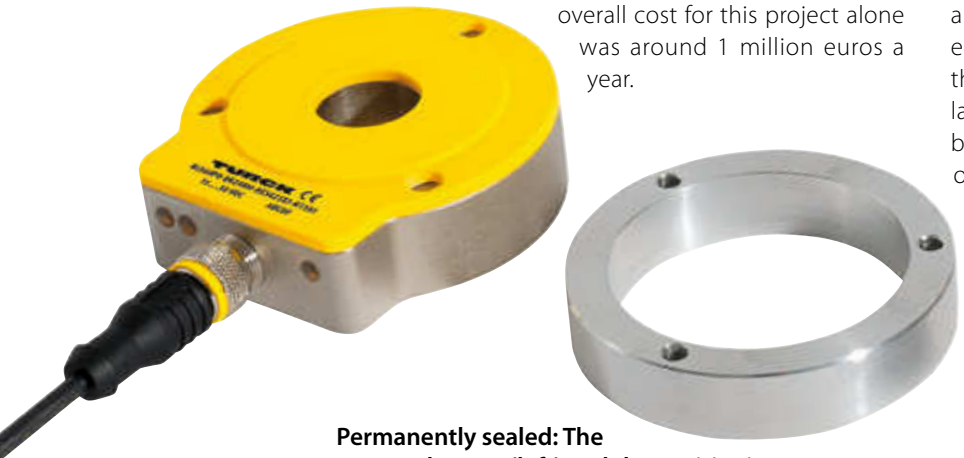
encorder series combine the benefits of the previous solutions while eliminating their disadvantages at the same time. They are wear-free, offer high resolution, high speed operation, are unaffected by vibration or magnetic fields, and meet the requirements of IP69K.

Fully encapsulated electronics

The resonant circuit measuring principle makes it possible to design a fully encapsulated sensor housing without seals, separate from the positioning element, eliminating the possibility of dust or water penetrating into the electronics. The non-contact measuring principle of the device enables it to compensate for vibration as well as an offset up to 4 mm. Magnetic fields cannot disturb the measuring process since the positioning element is not based on a magnet but on an inductive coil system.

The first customers, including a solar panel tower in Spain, are already waiting for the new device. Previously they used encoders in these heliostat power stations for aligning the mirrors to the central tower , but they had reached the limits of their capabilities. As the mirrors are positioned up to a kilometer away from the tower, changes of inclination have to be made in the millirad range (1 millirad = approx. 0.06 °) in order to project the light precisely onto the tower. Magnetic encoders do not have high enough resolution and optical encoders cannot withstand the extreme temperature swings of a desert climate. Hot days and cold nights cause a build-up of condensation which can't be prevented in an unencapsulated system. Water affects the electronic circuit and optical components, thus causing the sensor to fail. As the solar tower power stations are often located in remote areas stretched out over several square kilometers, replacing failed encoders incurs a major expense.

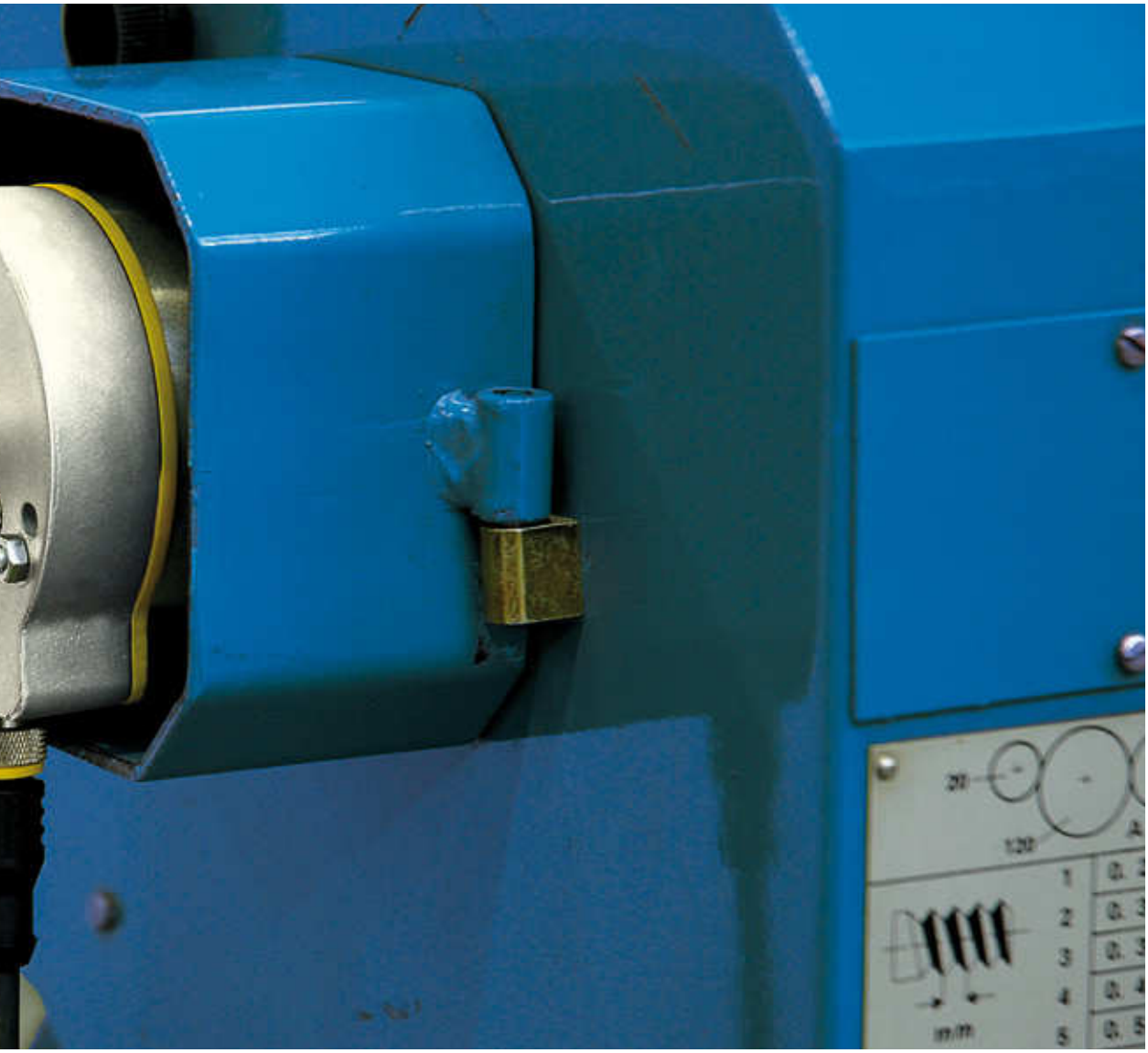
The maintenance-free RI encoder will provide great cost savings. Around 20,000 optical encoders are installed in the power station. The operators had to replace around a third each year due to faults or impending failures. At a unit price of 100 euros, this meant replacement costs of around 700,000 euros a year. Added to this are the costs for service technicians and the loss of power generation. The overall cost for this project alone was around 1 million euros a year.



Permanently sealed: The sensor element (left) and the positioning element (right) are fully encapsulated so that water cannot penetrate

Universal encoder replaces several 100 types

Turck's new encoder means that the user no longer has to choose between resolution and robust design. All the measures required to protect encoders from mechanical stress using springs or double bearings are no longer necessary. In addition to the interference immunity and wear-free design of the system, the user also benefits from the parameter and installation concept that allows a single encoder model to become a universal encoder for a countless number of applications. This single model can replace several different encoder types. The mounting concept also keeps this universal approach: Adapter rings make it possible for the user to fit the positioning element to shafts of different diameters. The user only has to keep a single encoder in stock which they can use for all applications on shafts up to 20 mm in diameter.



The well thought-out mounting concept and the non-contact measuring process offer several possibilities of installing the encoder with optimum protection

Turck is also launching a parameterizable IO-Link version on the market. The user can adjust the characteristics of the encoder and all its parameters individually to the application at hand via the IO-Link parameter interface. This way, the device can be parameterized as a multi-turn, single-turn or incremental encoder. The encoder can be set to resolutions up of up to 18 bits, even for the highest speeds. The customer can also parameterize the output signals to individual requirements: as an SSI, gray code or binary signal in 24, 25 or 26-bit resolutions, and as an incremental as well as a voltage or current output. Other variants will follow the IO-Link version in the coming months; one with a Modus RTU connection and a variant designed to e1 specifications for use in mobile machines with a 0.5…4.5 V voltage output.

The mounting concept of the sensor is just as flexible as its parameter concept. Shaft adapters enable the encoder to be used on all standard solid and hollow shaft thicknesses up to 20 mm. The sensor is designed in the shape of a donut and can be placed over the shaft via its center hole, with the positioning element fitted either behind or in front of it – depending on the permissible mounting conditions in the field.

The requirements of a customer from the machine tool sector illustrates how Turck's new encoder model is unlike anything on the market. This application is totally different from the one in the solar power station: While the measuring on solar panels is in the single-turn range, is very slow, and requires a high level of accuracy, the application on the CNC machine is in the multi-turn range, and requires measuring at up to 25,000 rpm. The speed is not a problem for the RI360P-QR24 since, unlike all other devices on the market, the encoder is not limited to a maximum speed.

Tremendous potential

The applications for the new encoder class are as varied as its possible configurations. Turck sees an enormous potential in several areas, including mobile machines, renewable energies, packaging machines, machine tools, as well as logistics systems and plants. However, the concept of the new Turck encoder class makes it an ideal solution for all sales markets and virtually all application fields, from which customers can benefit in the long-term. ■